ELECTRICAL REVIEW

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VIEWS, NEWS AND INTERVIEWS.

At the ensuing session of the British Parliament power will be sought to incorporate a company to construct a ferry to be worked by electricity on submerged rails across the river Thames, with roadways and approaches for the passage of vehicles, foot passengers, animals and general traffic, with generating station and electrical or other machinery and appliances.

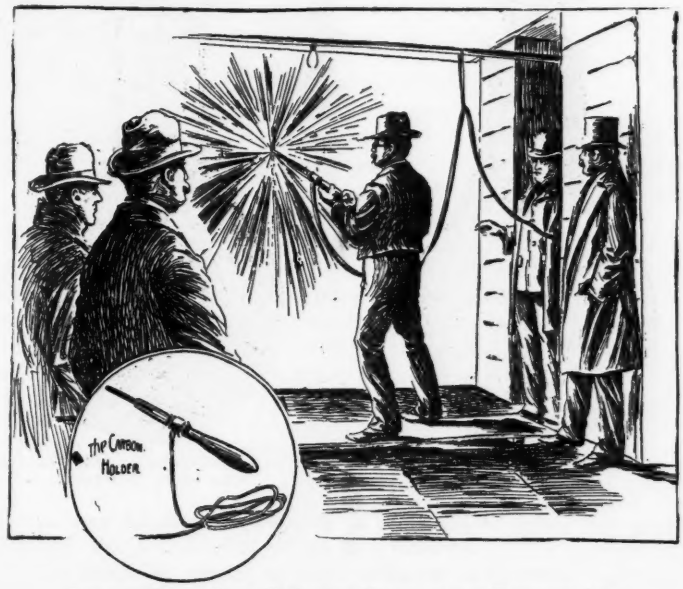
It is said in Washington that the government may, for a time at least, try control of the telegraph and telephone service in Porto Rico.

Col. Frank J. Allen, proprietor of the Astor House, is just now enjoying the badinage of his numerous friends over the fact that a large portion of his hotel was left in darkness by the breaking of the gas tank in New York last week. This famous old hotel, it is safe to say, will have the electric light in every room hereafter. Room No. 1, a noted meeting-place of local statesmen, was one of the rooms not affected by the accident, and the handsome electroliers there never shown with more brilliancy than on that occasion, and toasts to the electric light, the modern illuminant, were frequent.

A woman in New York city committed suicide in a novel manner one day last week. She had been ill and had received treatment from electrical apparatus supplied with bichromate batteries. Becoming depressed she drank the fluid contained in a battery jar and soon died.

A Montana paper tells of a remarkably quick trip of a car of freight from Schenectady, N. Y., to Butte, Mont., a distance of 2,660 miles. The car was loaded with electrical machinery for the Montana Electric Company. It left Schenectady on the evening of the 9th and arrived in Butte on the evening of the 16th, having been on the road just seven days. It was shipped over the Merchants' Dispatch Line to Chicago, and from there over the Northwestern to Council Bluffs, where it was turned over to the Union Pacific, which took the car to Butte, hauling it considerably over one-half of the entire distance, or about 1,500 miles. Only a few years ago that would have been considered very fast time for passengers.

During the recent blizzard in New York city a cumbersome electric-light sign on upper Broadway was blown off the top of a low building and, in its descent, severely injured a passer-by.



Burning Out a Bank Vault by Means of the Electric Arc.

The accident has called attention to the necessity for good work and careful inspection in installing work of this sort.

The War Department is having great difficulty in obtaining efficient telegraph operators to operate the military lines under the control of the United States Government in Cuba. A large number of operators were enlisted in the Volunteer Signal Corps, but these men were, in most cases, released from regular positions with the promise that at the end of the war they should be restored to their places. The telegraph companies have objected to keeping the offers open now that peace has practically been declared, and a large number of telegraph operators in the Signal Corps have been mustered out for this reason. The War Department now has about 300 miles of telegraph lines under its control in Cuba, and it is expected that many hundreds of miles now in use by the Spanish authorities will be controlled by this government when formal possession of the island is taken.

Mr. William A. Eddy, in a report to General Greely on the results of his kite experiment near the Statue of Liberty, in New York Bay, says: "Electrical tests of the absorbing power of the statue were made on November 1, 3 and 4. A Leyden jar was used on the last test, and reaffirmed the first discovery that the statue does not influence the air much beyond 100 feet in a horizontal direction from the statue, nor much more than 1,200 feet in a perpendicular direction above the torch. During the experiment four kites were driven into the water and destroyed."

Passengers on a trolley car running between Camden and Rockland, Me., recently enjoyed the novel experience of a race with a deer, which ran alongside the car for about 1,000 feet and then dashed off into the woods.

Destroying a Bank Vault by Means of the Electric Arc.

Thirty-five years ago a steel safe deposit vault was built by Miles Greenwood, a well known steam and mechanical engineer of that day, in the basement of the old Lafayette Bank Building at Cincinnati, Ohio. He was told to spare no expense, as a vault was wanted which would be perfectly safe. When Mr. Greenwood finished his task he informed his employers that the only way they could ever get rid of the vault would be by burying it. It was said to be the finest in the United States, and was built of steel two and one-half inches thick. The plates were screwed together, and the screws were then cut off and chilled. There were but two openings to the steel box, and these were doors fitted with all kinds of combination locks and bolts.

During the war this vault contained a large part of the valuables in Cincinnati. Later there were other and more modern safety vaults constructed, and the company which owned it passed out of existence, but the vault still remained. For 10 years the Lafayette Bank officials have been wanting to get rid of the vault, as they needed the room it occupied. Contractors were informed that they could have the steel if they would take the vault away, but they found that there was only one way to get rid of it and that was to blow it up. If that were done, the building would go with the vault. Finally, Mr. William Stacey, of the Stacey Manufacturing Company, was sent for, and after looking over the job accepted the contract, not to remove all the vault, but to leave enough of it so that the bank could use it for a safe for its books. Then the bank officials asked Mr. Stacey how he was going to do the job, and he informed them he was going to burn out the vault.

The Devere Electric Company was called in, and a few days ago the task was begun. They tapped one of the arc light wires, and a rubber-handled tool carrying an arc light carbon was attached to the circuit. Luke Lilley, of the Devere company, made the

various connections, and, equipped with a pair of heavy goggles, turned the switch and started to work. At the first experiment a hole as big as two silver dollars and one-half inch deep was burned in the hard steel in less than a minute. In a comparatively short time a hole was burned clear through the steel plate, much to the astonishment of the bankers who were present at the test. Some slight changes were made in the experimental apparatus, and it is presumed that Mr. Stacey will carry out his contract with entire success.

ELECTRIC LIGHT FLASHES.

The Citizens' Electric Light Company, of Houston, Tex., will erect a plant at a cost of $150,000.

The Clyde, N. Y., Gas and Electric Company has bonded its entire plant for $25,000, in favor of the Trust and Deposit Company, of Syracuse.

A company with $1,000,000 authorized capital has been formed to utilize the power of James River at Richmond, Va. An electrical plant will be at once constructed. It is said that 8,000 horse-power can be obtained.

The New York Gas and Electric Light, Heat and Power Company has purchased half a block of land at First avenue and Ninety-seventh street, New York city, adjoining the site of the Metropolitan Street Railway Company's big power-station.

An Imperial irade has been issued by the Sultan of Turkey granting to Sir E. Ashmead-Bartlett, a member of the British House of Commons, a concession for the establishment, with a monopoly, of an electric lighting system in the towns of Salonica and Smyrna.

At the annual meeting of the Sunapee, N. H., Electric Light Company the following officers were elected: President, Joseph Russell; vice-president, Nathan A. Smith; secretary, Moses L. Sargeant; treasurer, Alfred C. Sutherland; directors, Willis W. Prow, Mrs. Moses F. Knowlton and George A. Hart.

At a meeting of the stockholders of the Hummelstown, Pa., Electric Light, Heat and Power Company the following board of directors was elected: Dr. W. C. Baker, W. H. Ulrich, Allen K. Walton, F. J. Schaffner, Robert J. Walton and J. P. Nissley. The board then organized by electing Robert J. Walton, president; T. J. Schaffner, secretary, and Allen K. Walton, treasurer.

A Continuous Globe Arc Lamp.

The Jandus Electric Company, arc lamp manufacturers of Cleveland, Ohio, have developed a new type of the Jandus enclosed arc lamp which is illustrated herewith. It is called the "continuous globe" lamp, and possesses several novel features. Among these are a continuous globe surface below the arc, ready accessibility to mechanism, rigidity of globe in lowered position, and what is claimed to be the quickest "trim" ever devised.

In the accompanying illustrations Fig. 1 shows the neat and compact external construction of the lamp. As there is no lower external globe

FIG. 1.—A CONTINUOUS GLOBE ARC LAMP.

support, the surface of the globe is made continuous, thus obviating any shadow and affording an attractive design. The globe is lowered for trimming by a slight upward pressure with one hand and a turn to the left. This unlocks a special device and permits the globe to slide down to the position shown in Fig. 2.

The outer globe is securely fastened to a ring or collar which is maintained in a horizontal plane in any position, and holds the globe in rigid relation to the lamp structure. It is claimed that no lamp heretofore designed has this important practical feature without embodying devices by which the globe is supported at its bottom. Thus, in trimming, the continuous globe is held rigidly while lowered—a feature which all lamp trimmers will appreciate. The inner globe and lower carbon can be very quickly and easily removed for cleaning and retrimming.

To restore the outer globe to its normal position, it is simply raised or shoved upward with one hand. When at the proper point it turns by torsion of the side rods firmly into a locking device. Thus the lamp embodies what the makers state is the most rapid trimming device ever offered in connection with enclosed arc lamps. The case, by a slight turn, can be

FIG 2.—CONTINUOUS GLOBE ARC LAMP WITH GLOBE LOWERED.

dropped to expose the working parts of the structure, which are of the regular Jandus "25-inch" type.

Telephone News .....and Comment

The Ardmore Electric and Chickasaw Telephone companies paid their first dividend of eight per cent on November 15. The officers of the companies are as follows: C. A. Ross, president, Chicago; Robert W. Hodge, secretary, Kansas City; A. J. Wolverton, treasurer.

The Boston & New York Telephone and Telegraph Company has filed articles of incorporation at Trenton, N. J. The capital stock is $1,000,000, and the incorporators are Zephaniah S. Holbrook, of Cambridge, Mass.; Oakes Ames, of Milton, Mass.; Frederick A. Spear and Charles E. Adams, of Lowell, and J. Stewart Rusk, of Boston.

Manager Lerch says that the Pennsylvania Telephone Company lately put up the largest single span of wire that is strung in Pennsylvania, or possibly in the United States. It is 1,600 feet long and stretches across the Delaware River from Lambertville, N. J., to Newhope, Pa.

The Bell Telephone Company won the tax suit in Toronto, mentioned in the ELECTRICAL REVIEW last week. The three county judges, who have been hearing the appeal of the company from the assessment as fixed by the city of Toronto, have given judgment reducing the assessment more than half a million dollars.

The recently elected board of directors for the Home Telephone Company, of Fort Wayne, Ind., met last week for the purpose of electing officers for the company. This resulted as follows: President, Charles Bash; vice-president, C. F. Hettler; secretary, William L. Moellering; treasurer, Max Fisher.

After four weeks of work the Chicago Telephone Company has completed the transfer of 1,000 lines of its exchange to the Title and Trust Building, 100 Washington street, Chicago. The transfer of these lines, called by General Manager Hibbard the busiest in the world, caused a delay on each line of only five minutes while the change was being made.

Several members of the New York city Municipal Assembly are said to want the city to establish a telephone system of its own with plenty of wires and instruments for the use of all departments. A request from the Commissioner of Water Supply for more telephones for his department has been defeated in the Council. Several of the Councilmen say that the city can save money by putting in its own telephones, and they refuse to vote for any increase of the number of rented ones.

The Massachusetts Telephone and Telegraph Company has secured a franchise to operate in Boston. Mr. Z. T. Holbrook, promoter and president of the company, was formerly Chicago manager of the Lamson company. Minor officials of the Lamson company have been interested in independent telephone companies in the West for some time past. It is said that no money has been paid in as yet. Its capital of $10,000 is only nominal. It is proposed to capitalize the company at $2,000,000, and a canvass for subscribers is to be made.

A MODERN ELECTRIC RAILWAY STATION.

NEW ELECTRIC PLANT OF THE METROPOLITAN RAILROAD COMPANY, OF WASHINGTON.

The Metropolitan Railroad Company, of Washington, D. C., is installing in its former car barn on P street, between Twenty-fourth street and Rock Creek, a plant which, when completed, will make, it is claimed, the most thoroughly equipped power station of any electric railway company in the District of Columbia.

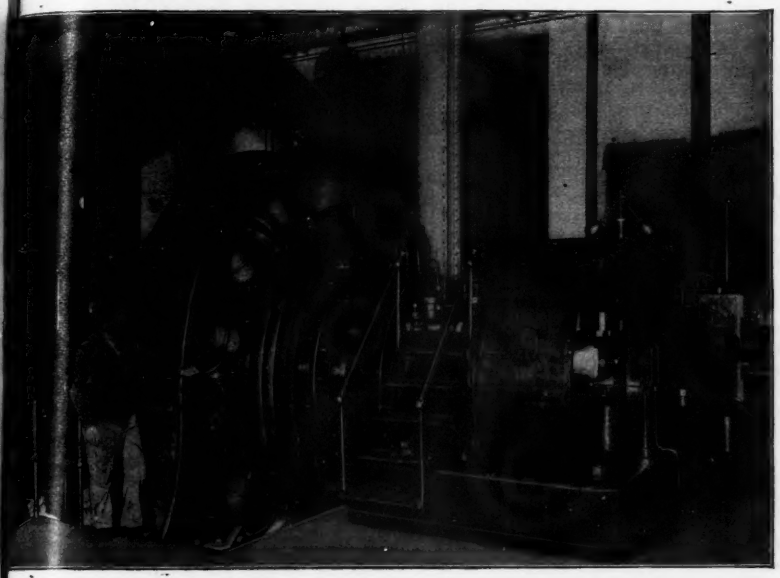


FIG. 1.—A MODERN ELECTRIC RAILWAY GENERATOR (850 K.-W.), USED BY THE METROPOLITAN RAILROAD COMPANY, OF WASHINGTON, D. C.

The improvements consist of one 1,200-horse-power McIntosh & Seymour tandem compound-condensing engine, directly connected with a General Electric Company's generator of 850 kilowatts capacity. The cylinders are 26 and 56 inches in diameter, respectively, with 48-inch stroke, and make 90 revolutions per minute. The flywheel weighs 80,000 pounds. The shaft is 22 inches in diameter, and weighs 34,000 pounds. The armature of the generator is nine feet in diameter, and weighs 50,000 pounds, while the total weight of the generator complete is 120,000 pounds. The weight of the engine, complete, is 210,000 pounds, and the aggregate weight of the engine and generator is 330,000 pounds.

While the nominal rating of the engine is 1,200 horse power, it is guaranteed to produce 1,910 horse-power. Attached to each of the other condensers is a Worthington jet condenser, with compound steam cylinder.

The overflow and water of condensation will be discharged through a Worthington cooling tower, and the water cooled and the same used over again for condensing. By this arrangement a limited quantity of water can be made to perform operations which otherwise would require a supply of 3,000 gallons a minute, or 180,000 gallons per hour. The water in the tower will be cooled by air being forced through it by two eight-foot fans, which will be driven by a specially designed electric motor, and whose variation in speed can be made to equal 100 per cent—as, for example, in cool weather the fans will average 200 revolutions per minute, while in very hot weather it may be necessary to drive the fans at 400 revolutions per minute.

When the equipment is put into service the P street power house will comprise, in addition thereto, two 750-horse-power tandem compound-condensing engines, and directly connected with them, two General Electric Company's railway generators of 500 kilowatts capacity each. These engines and generators are of the latest type, and the current output from the machines is at a pressure of 600 volts. The current from the generators to the street is controlled by a switchboard, on which are the instruments for measuring and recording the current output, and the switches for controlling the different sections of the circuit, of which there are six. Each is controlled independently from the other from the station.

The steam to run all this machinery will be generated from six boilers of the water-tube type. Three of these are of 200 horse-power each, and each of the other three of 300 horse-power, making 1,500 horse-power in all. The usual arrangement of Worthington feed pumps and feed-water heaters will be used to supply the boilers with water.

Three of the furnaces are supplied with Murphy mechanical stokers.

There is also being installed a specially constructed engine and generator for lighting the station and car shed, and an air compressor for the purpose of cleaning cars and performing other work by the use of compressed air.

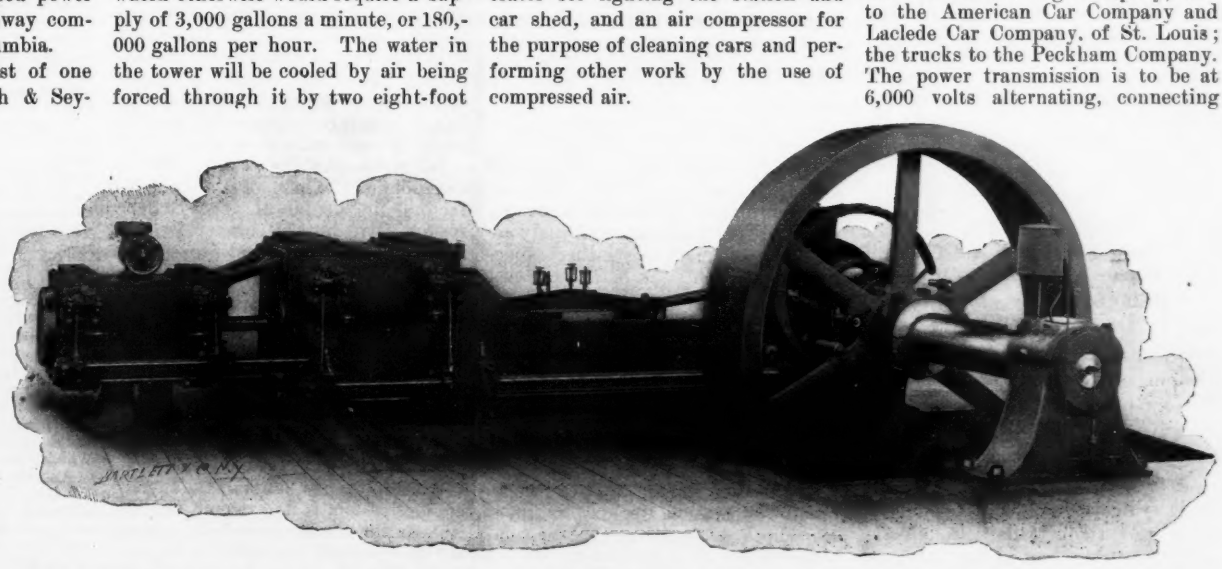


FIG. 2.—A MODERN ELECTRIC RAILWAY POWER-STATION ENGINE, USED BY THE METROPOLITAN RAILROAD COMPANY, OF WASHINGTON, D. C.

ELECTRIC RAILWAY NOTES.

A new electric railway has been chartered, with a capital of $200,000, to connect Allentown, Pa., with Slatington, a distance of 17 miles.

The Cleveland & Chagrin Falls, Ohio, Electric Railway Company has bonded its line for $300,000, and will build an extension to Warren at once.

A deal is said to be pending involving a number of Ohio electric railways. It is the consolidation of a number of interurban electric railways, including those now in operation between Piqua and Troy and Dayton and Troy, and lines that are now under course of construction between Cincinnati and Dayton. It is now possible to travel over different interurban railways between Cincinnati and Dayton, Ohio, in less than twice the time it takes the quickest railway train, and for just one half fare.

A consolidation of the Baltimore Consolidated Railway Company, the Baltimore City Passenger Railway Company, the Baltimore & Northern Railway Company and the Baltimore Middle River & Sparrow's Point Railway Company was brought about last Saturday. This brings all the street car companies in Baltimore, Md., under one management. The deal, which was engineered by Alex. Brown & Sons, is the biggest ever consumated in Baltimore, involving some $28,000,000. A new company will be formed which will take over the combined properties.

The Eckington & Soldiers' Home, now the City and Suburban Railway Company, of Washington, D. C., have awarded the contract for car equipments as follows, for 50 to 60 cars, to consist of 2 and 4 motors, No. 49: Equipments to the Westinghouse Electric & Manufacturing Company; cars to the American Car Company and Laclede Car Company, of St. Louis; the trucks to the Peckham Company. The power transmission is to be at 6,000 volts alternating, connecting through relay converters of the Westinghouse type. One of the local power companies will supply the current to the transformers. The work of reconstructing this company's system of horse cars to the underground double-conductor trolley system is well under way.

SURFACE CONTACT ELECTRIC RAILWAYS.

READ BEFORE THE NEW YORK ELECTRICAL SOCIETY, NOVEMBER 17, 1898, BY EDWARD H. JOHNSON.

(*Concluded from page 361.*)

Considerable prejudice against the use of the tracks and the earth as a "return" conductor having been developed through the inefficient methods employed in the early days of the overhead trolley, and great stress being put upon the fact that in the open conduit system the track rails were not used as conductors, we thought it well to evolve, if possible, an alternative system in which the track rails and earth need not be employed as conductors. Our work in this direction is of an eminently practical character, not only retaining all of the good elements of the "track return" system, but involving a new feature in the line of securing safety; viz., the reversal of direction of leakage currents from that taken by the motor current in passing through the negative switch, thus guaranteeing the "opening" of the switch and consequent discharge of the current from the street surface upon the passing of the car.

To fully understand the method of accomplishing the above features, reference is made to Figs. 11 and 12 where RR′ represent the tram rails; SC′, SC^3, SC^5, etc., one line of sectional rails; SC^2, SC^4 and SC^6, another line of sectional rails, and B′, B^2, B^3, etc., contact points for delivering the positive current, the arrangement of conductors being clearly shown in Fig. 12, which represents a cross section of the roadbed.

It will be noticed upon examination of the diagram that when the switch M′, for instance, is open as shown, the positive main conductor and the negative main conductor are connected only to carbon contacts in the switch itself, there being no permanent connection between the sectional conductors or the tram rails and the negative main.

It will also be noticed that the current for energizing the electro-magnetic switches (see magnet M^2) flows from the track rails through the switch coils to one of the sectional conductors belonging to the row SC′, SC^3, SC^5, etc.

Any leakage from the contact point B^2 would have a tendency to flow from said point to sectional conductor SC^3, then through the switch coil in opposite direction, demagnetizing the same, to track rail and to the positive sectional conductor SC^4, which is the negative service conductor, from which it will be fully understood that any leakage currents, after the car has passed, have a tendency to quickly open the electro-magnetic switch.

There has been a deal of superficial talk about the destruction of gas, water and other pipes by vagrant currents from the track rails when these are used as the return conductor. It is true that in the earlier equipments of the trolley roads too little attention was paid to securing a thoroughly good bonding of the rails and otherwise providing for giving them a sufficient conducting capacity, and that under such conditions the electric current seeking a pathway of lower resistance would traverse any contiguous conducting body, thereby effecting more or less injury thereto through electrolytic action. When, however, this fact had once been made clearly manifest, additional attention was given to consolidating the rails by electric binding and otherwise, so as to give ample conducting capacity, with the natural result of so minimizing the vagrant currents as to well nigh eliminate their destructive effect; in fact, notwithstanding that much has been said of late upon this subject, it is an open question whether the evil actually exists where intelligent work has been done in laying the track rails. If, however, it is held to be desirable to have an absolute guarantee against such action it is not at all necessary to abandon the simpler system of a single-wire conductor and track return and go to the complex two-conductor system. It is quite within the electrical engineer's ability to completely eradicate the defect by the simple means of employing asphaltum about the base and sides of the rails when they are laid; the insulation thus afforded, though not of high quality, would yet be ample to care for the comparatively slight tendency of the current to leave the track rails and seek other conductive bodies.

The importance of preserving a smooth and unobstructed street surface is far greater than that of safe guarding against a wholly problematical injury to gas or water mains, but there is, I repeat, absolutely no necessity of incurring either objectional condition. Moreover, the cost of so insulating the rails as to eliminate all leakage would be trifling in comparison with the laying of a system of double conductors.

Having thus encountered and overcome every possible obstacle, whether raised by virtue of our own foresight, the criticism of others or the operation of the system upon experimental trial, we determined to put in, in practical operation, upon a prominent New York street and prove the complete efficacy of all its factors "in the eye and under the nose" of railway managers, municipal authority and the public at large. This was done, and the demonstration, continuing over a period of eight months, proved conclusively that the system was reliable, economical and safe in all weathers and under all conditions of street surface. The sole criticism—one evolved, by the way, more from a predetermined intent to condemn than upon an honest judgment—was as to the physical obstruction of the streets by the two rows of buttons then employed in the system as the contact points. This criticism had a colorable ground under the conditions with which the work was environed, which were:

1. The work was done in the Winter season, with frost on the ground.

2. The buttons were founded upon the same unyielding base as the track rails, in order to keep their top surface in the same plane as the track rails. The pavement, in turn, was founded upon sand. The inevitable consequence was a settling of the pavement on the disappearance of frost, and a consequent considerable protruding of the buttons above the street surface, thus creating an objectionable obstruction to horse and wagon traffic.

The simple remedy for this fault was, of course, to give to the street pavement as complete and satisfactory foundation as was had by the buttons themselves, and as is done in cable and open conduit work. But the critics of the system were not seeking *light*—they were after damnatory points, and though compelled to admit the satisfactory operation of the system, its safety, etc., and even that the buttons would not be objectionable upon the street of a European city, where pavements were better laid, they adhered to the conclusion that upon our streets the buttons would be condemned by municipal authority.

While still combating this view and insisting upon the entire feasibility of so consolidating the buttons and the pavement as to maintain their surfaces always in the same plane, we have, nevertheless, in pursuance of our policy of confronting every hostile and prejudiced criticism with a complete antidote, sought and found a way and means of dispensing with the buttons altogether, substituting, therefore, simply a single third rail, sectionally divided and so laid as to insure its perpetual identity with the track rails themselves.

In accomplishing this without abandonment of any of the valuable factors incidental to the button system, Mr. Lundell has evolved an invention which may yet prove to be the "key" to the whole problem, particularly in view of the fact that it not only simplifies the system but materially reduces its cost. A description of this invention can not now be given, as the patents are still pending, but a sketch of the street surface is appended (Fig. 13) to convey an idea of the appearance of a street in which our system is installed.

An important quality of the surface contact system is its extreme flexibility—unlike the open-conduit system, all its operative parts are on the surface. It is, therefore, entirely feasible to pass at full speed from the surface contacts to an overhead trolley, and vice versa. There is no "plough" or other incumbrance to remove.

A storage battery may be likewise combined with the system to operate the cars over unequipped portions of a line. The battery need not be removed from the car for charging, as it is being constantly charged while passing over the equipped sections.

The accompanying opinions of Lord Kelvin and the late Dr. John Hopkinson, the one the greatest theoretical authority in the world and the other undoubtedly the best authority on practical application of electricity, attest and support the verbal expressions in support of the system, made by such authorities as Thomas A. Edison, Frank J. Sprague and others. Dr. Hopkinson, in his advisory capacity as consulting engineer for English and continental railways, strongly recommended the system to at least one of his clients, who now only awaits parliamentary action to give it a practical trial.

The railway manager who first applies this system will achieve more in the way of ridding our streets of the objectionable overhead wires than have all the laws that have been enacted for this purpose.

REPORT BY LORD KELVIN ON THE JOHNSON-LUNDELL SYSTEM OF ELECTRIC TRACTION.

I have carefully examined the Johnson-Lundell system for electric tramcars, driven by current supplied from underground conductors, and I find in it realized all the conditions required for practical success. It provides simple, trustworthy and durable mechanism for energizing the motor and driving the car, with exceedingly little loss of energy in the surface and underground connections. For street tram lines it gives very perfect security to the public against the possibility of coming in contact with anything at high pressure electrification on the roadway, and thus does away with all danger of electric accident, whether to horses or men. It is founded on the general principle of arranging for the car to automatically make and break connection between metals on the roadway and a high pressure wire insulated below it, which was patented many years ago by Dr. Hopkinson. Many attempts to work out this valuable principle have been made by ingenious inventors and able engineers, but without any thoroughly satisfactory results, until in the Johnson-Lundell system the various causes of more or less complete failure of previous attempts have been eliminated and practical success, proved by thoroughly good working for about five months on West Thirty-fourth street, New York, has been realized.

In this system, as in some of the previous attempts, the connections between roadway metals (studs or divided rails) and the underground high-pressure conductor are made and broken by the action of an electro magnetic switch. A peculiarity of vital importance in the Johnson-Lundell system is that the current actuating this switch can not possibly, by surface leakage or otherwise (however wet, if even by melted snow, the ground may be), be maintained after the carriage passes over the corresponding part of the roadway. There is, therefore, no possibility of any metal on the roadway being kept in connection with the underground high-pressure conductor, except in places actually under the tramcar, and thus security against electrical accident to man or horse on the street to which I have referred, is obtained.

Another very important peculiarity of the Johnson-Lundell system is the method of dividing the coil of each electro-magnet into two parts, A and B, connecting one end of the A of each magnet to the uninsulated main tram rails, and connecting the other end of each A to one end of the B of one of its neighboring magnets in the series, and the other ends of all the B's to the series of low-pressure studs on the roadway. The high-pressure studs are connected through the break contacts of the electro-magnetic switches to the main supply conductor. By this arrangement the magnetic switch, immediately in front of an advancing car, is excited, and its contact piece makes connection between its corresponding high-pressure stud and the main supply high-pressure conductor, before this stud is touched by the high-pressure con-

tact shoe of the car. Thus, when the car advances far enough for its high-pressure shoe to make contact on this high-pressure stud it finds this stud already at the proper high-potential; and, after advancing about a foot further, the high pressure stud immediately behind it on the road is left behind by the shoe without any spark on breaking contact. A little later the low-pressure shoe makes contact on the low-pressure stud a little in advance of the car, and immediately after breaks contact sparklessly from the low-pressure stud immediately behind it on the roadway. This stops the current through the magnetic switch under the rear end of the car and allows the contact piece to fall, and so break connection between the high-pressure stud under the rear of the car and the insulated conductor. Thus all the contacts are made and broken sparklessly and surely without the aid of any shunt wire coils or fine wire coils. The currents through the conductors of the two magnets of the two switches, simultaneously excited, are perfectly definite, and there can be no variation or "pumping" between them, whatever be the condition of the roadway in respect to rain, or snow, or mud.

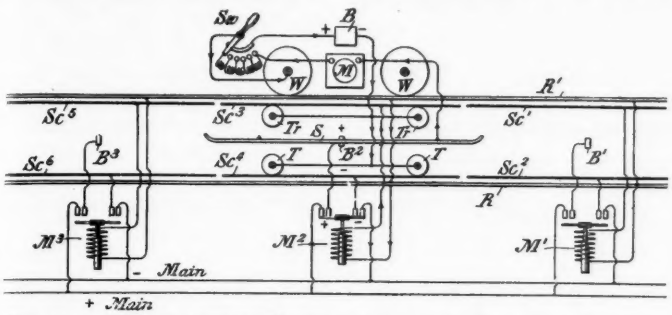


FIG. 11.—"SURFACE CONTACT ELECTRIC RAILWAYS."—METHOD OF AVOIDING EARTH RETURN.

I have carefully examined all the details of the electro-magnetic switch and of the arrangements to preserve it against damage or disturbance from moisture in its position under the roadway, and I find them thoroughly well adapted for keeping it constantly in working order in the most trying conditions of tramway traffic.

Considering all the circumstances, I feel very confident that the Johnson-Lundell system will be found thoroughly efficient and trustworthy for electric traction.

(Signed) KELVIN.

London, July 16, 1896.

THE JOHNSON-LUNDELL SYSTEM OF UNDERGROUND TRAMWAY CONDUCTORS.

I have read the English specifications of Johnson & Lundell, Nos. 1,003 and 13,765, of 1894, which describe their arrangement of conductors for tramway purposes in its earlier state. I have also read the American specification of Lundell, No. 560,313, of 1986, which describes the invention in its final form. I have seen the automatic electro-magnets manufactured for the purpose of carrying out the invention in the form which has been given to them after practical experience.

I have for 12 or 14 years given some attention to the question of underground conductors for tramway purposes designed with the intention of getting rid of the overhead conductors—which are certainly undesirable in large towns—and many years ago I myself obtained the first patent for connecting and disconnecting automatically sections of the conductor by electro magnetic means. This was, however, never practically carried out by me, and I understand that, when Messrs. Johnson & Lundell did in fact put it into practice, they found defects in the system which their inventions have been designed to obviate. I mention this for the purpose of showing that I have given such attention as will entitle me to speak with some authority.

Broadly speaking, in all such systems there is a conductor divided into sections and exposed in the surface of the road, but the sections of this conductor are not intended to be connected to the source of electrical supply, except at such times as they are covered by a car; the result being that it is impossible either for a person or a horse to come in contact with the conductor which is connected to the supply, and hence impossible that they can receive any shock. This system of only permitting the conductor, with which contact is made, to be connected with the supply conductor when it is actually in use has the incidental advantage that thereby leakage of current is minimized. Messrs. Johnson & Lundell's invention is addressed to making this general idea effective. They provide between the rails a row of iron studs which project slightly above the surface of the road. These studs give the supply of current to a suspended bar beneath the car, extending the major portion of its length. In addition to this there is a subsidiary divided rail placed near to, but outside, the rails upon which the cars run; and each stud between the rails is connected through an electro-magnetic switch to the conductor which brings the current from the generating station. On the magnet of this electro-magnetic switch are wound two coils; one end of one of these coils is connected to a section of the conductor placed in the road outside the rails, the other end passes on to the switch belonging to the next stud and passes round one of the coils of its electro-magnet and thence on to the rail. The action then is as follows: The current passes from the supply conductor to a stud between the rails with which it is connected by means of an automatic switch; thence it passes through the motor upon the car and then to the bar or slipper which makes contact with sectional conductor outside the rails. From this it passes through the electro-magnet, which maintains the contact with the stud, and then around the electro-magnet next in advance, which is also energized, and so closes the next switch. It is obvious that as the car passes along the switch next in advance is lifted before the bar under the car makes contact with the corresponding stud, and that when the car has left the stud the switch with which that stud is connected will drop and disconnect the section.

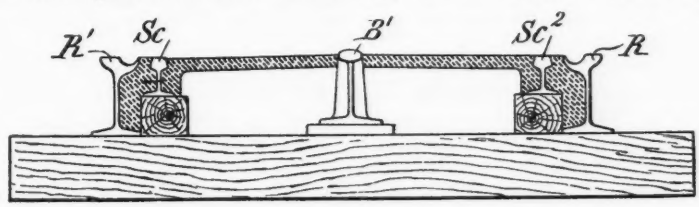


FIG. 12.—"SURFACE CONTACT ELECTRIC RAILWAYS."—ARRANGEMENT OF CONDUCTORS.

A very little consideration will satisfy any one that under ordinary circumstances this construction will work. It remains to point out how the particular construction renders working secure and certain at all times. In the first place it is to be noted that the successive studs are rendered alive before contact is made with the bar under the car. This prevents destructive sparking and uncertainty in the contact. Next it will be observed that the electro-magnet is connected in the circuit at that part which is near to the earth potential, and that as the sectional conductor is placed outside the rail, if there be any leakage of current from the stud, such leakage can not pass through the electro-magnet and so maintain the switch in the position which places it in connection with the main supply conductor. This insures that under no circumstances of weather can a stud fail to become disconnected from the conductor when the car has passed away from it. This, of course, is essential, as otherwise persons coming in contact with the exposed stud would receive shocks and horses would be killed.

On the whole, I am so satisfied with the Johnson-Lundell system of conductors that I should not hesitate to approve its adoption in any town in which overhead conductors were inadmissible. I have not the least doubt that it would work thoroughly, effectively and safely.

(Signed) J. HOPKINSON.

FOREIGN ELECTRICAL NEWS.

Death of De Meritens—The death, by suicide, of M. de Meritens, an electrical inventor of considerable genius, is deplored by the French press. He was at one time well known in the world of electricity, having been the inventor of a magneto-electric dynamo which is still in service in several of the French light-houses, and which replaced the old makes of Holmes and Alliance. His other inventions, which were numerous, not succeeding as well as this one, M. de Meritens became discouraged at his repeated failures and committed suicide, after killing his young wife. He was 65 years of age.

The Houllevigue Prize—The French Académie des Sciences has, this year, awarded the Houllevigue prize of 5,000 francs, and it is learned with satisfaction (says *L'Electricien*) that the commission has decided to bestow it on M. Ed. Branly, whose invention of the Branly tubes has well deserved the honor bestowed upon him. These tubes have stood the most satisfactory tests in the recent experiments carried out in telegraphing without the aid of wires. Our contemporary adds that the bestowal of the prize on M. Branly is all the more deserving of approval by his countrymen, because the tendency has been to rob that gentleman of his dues on the ground that his most important discovery (the properties of radio-conductors) belongs by priority to a foreigner. His right to the honor of having been the first to make the discovery is thus officially established by the académie.

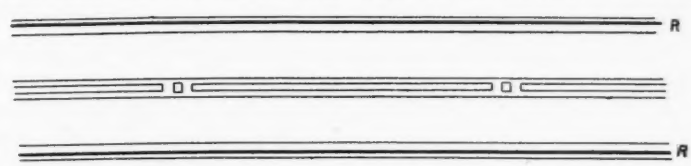


FIG. 13.—"SURFACE CONTACT ELECTRIC RAILWAYS."—SKETCH SHOWING APPEARANCE OF STREET EQUIPPED WITH JOHNSON-LUNDELL SYSTEM.

Electric Tramways in London—The London County Council, which was opposed to the introduction of electric traction in the city otherwise than by the underground system, has again taken up the question on repeated demands of the London Tramway Company, which is desirous of installing the overhead or trolley system on one of its lines. The result of the discussion between the council and the company is that the latter has been authorized to go ahead with a small section of the line, some two miles in length, the condition imposed being that it will install the underground system on two other sections. The intention of the council is probably to have in the vicinity of the city two sections that may serve as tests of the two systems in use. By this means they no doubt hope to settle the question of which is the better of the two, and the more suitable for the complete transformation of the London tramway lines. The subject is one of importance for the London County Council, as, in January next, it will become the owner of 80 miles of tramway which it has purchased from the company. The transformation of the lines into electric ways will be begun as soon as the council is of the opinion that the stage of the possible has been reached. Mr. A. H. Barker, who has been intrusted with the compilation of a report in which he is to set forth his views on the subject, is of opinion that the underground system is the most adaptable for the interior of the city, although the cost will be in excess of that which the city would be called upon to pay if the trolley system were adopted. In the meantime the London traveling public is awaiting the outcome with interest, doubtless thinking that any system would be better than the one which has always scandalized the capital of the British Empire.

Electrical Review

OLDEST ELECTRICAL WEEKLY IN THE UNITED STATES.]

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SPECIAL NOTICE TO ADVERTISERS.

CHANGES for advertisements must be in this office by Friday noon for the following week's issue. NEW ADVERTISEMENTS should be in the office not later than Saturday noon to insure publication the following week.

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A Merry Christmas and a Happy New Year to all! 1898 has been a good year for the ELECTRICAL REVIEW, and we believe 1899 will be still better.

There is to be an exposition in honor of Volta. This distinguished inventor, now deceased, was a self-made man—so all claims on the part of our terra-cotta contemporary are barred.

ELECTRICAL CONSOLIDATIONS.

During the past few months an unusual number of consolidations have taken place in the electric lighting and street railway fields, and more especially in the former. Among the most prominent of these was the purchase by the Kings County Electric Light and Power Company of all the other central electric lighting plants in Brooklyn, N. Y. This, at the time, was considered an unusually important transaction, as indeed it was. Following this came the incorporation of the New York Electric Light, Heat and Power Company, with a capital of $25,000,000. At the time no good reason could be discovered for its existence. Within a few weeks, however, it was learned that several franchises of established central lighting plants in New York city had been acquired, and it was rumored that an alliance had been formed under which the New York Electric Light, Heat and Power Company was to purchase the present surplus current of the Metropolitan Street Railway Company and to use a number of its extra underground conduits, recently installed in Broadway and other streets in New York city proper. A fact which renders this rumor more striking is that, within a few days, it has been asserted that this company has purchased a site for a new power-house adjoining that recently acquired by the Metropolitan Street Railway Company.

Further recent rumors are to the effect that it is among the possibilities that a working arrangement, or perhaps something closer, may be made between the Kings County Electric Light and Power Company and the New York Electric Light, Heat and Power Company for the supplying of current to consumers in both the boroughs of Manhattan and Queens. This, it is inferred, would involve the transmission of current across the Brooklyn Bridge, or by tunnel.

In a similar manner consolidations of electric lighting interests have taken place in Philadelphia, Boston, Trenton, N. J., and numerous cities in Connecticut, where several gas companies owning electric lighting plants are involved. The latest street railway consolidation is that in Baltimore, where all the local railway lines have been brought into one company under one management.

So many of these consolidations taking place within a comparatively short time makes the occasion noteworthy and raises an inquiry as to the underlying reasons. In general, it may be stated that properly managed central stations in large cities inevitably produce good returns on the capital invested. A striking example of this fact is shown in the operations for the past two or three years of the Edison Electric Illuminating Company of New York. Not only have the gross and net earnings of this company increased steadily, but the company has also reduced its price of current to consumers to such an extent that no good business man carrying on trade in any street in New York in which the company's service is available can afford to do without electric light or electric power, if power of any kind is needed.

It seems to us that the moral to be drawn from the circumstances mentioned above is, that the use of electric current has become so universal, and that so many millions of dollars of capital are invested in electric lighting companies providing for this demand, that consolidation of competing stations is but a logical consequence of the business situation. It follows, of course, that great reductions in operating expenses can be made if several plants are managed by the same officials; and the consolidation affords an opportunity to replace old style with modern and more economical apparatus. Experience in other lines has shown that, where such economies are effected by consolidations, a large part of the saving accrues to the immediate and direct benefit of the consumer. It is, we believe, fair to assume that in all the large cities of the United States, and in some of the smaller ones, where consolidations of electric light, power and street-railway interests have been effected, the general public will be the greatest gainers, and the use of electricity will be extended further and more rapidly than it could be by any other means.

WALL STREET AND THE ELECTRICAL STOCK MARKET.

The week just closed was a record-breaker on the New York Stock Exchange, having witnessed the largest business in its history. The total sales of stocks were 4,253,228 shares, and the total sales of bonds amounted to $37,877,000. Both these figures constitute new records. The number of different stock issues dealt in was 203. On Tuesday alone 914,332 shares of stock changed hands.

The stock market was extraordinarily active and buoyant during the week just closed, chiefly for the same reasons given in this column for the past month, backed up by national prosperity and our wonderful foreign trade. It is stated that during the past two years the United States have sold to the remainder of the world nearly $1,000,000,000 more of its products than it has bought of other countries. We have received and are still receiving gold and securities in exchange. We are also loaning money abroad.

It is now estimated by competent judges that the exports of American electrical apparatus for 1898 will amount to between $3,000,000 and $4,000,000. One company alone will have exported $600,000 of its apparatus by the close of the year.

Almost every line of industry in the country is engaged up to the limits of its facilities. This is especially true of the electrical industry as a whole. Every indication points to New Year's day as the opening of a period of extraordinary national prosperity.

The directors of the Westinghouse Electric and Manufacturing Company have declared a quarterly dividend of 1¾ per cent on the company's preferred stock, payable January 3. Books close December 24 and reopen January 4.

On the New York exchange, General Electric closed at 92¾ bid and 93½ asked, a gain of 4¼ points for the week, 8½ points for two weeks and 11 points for three weeks. Edison Illuminating of New York closed at 189 bid and 191 asked, a gain of 6 points for the week. Western Union closed at 94⅜ bid and 94½ asked, a loss of ⅞ point for the week. On the Boston exchange American Bell Telephone closed at 276 bid and 277 asked. Erie Telephone closed at 76 bid and 76¾ asked. On the Philadelphia exchange, Electric Storage Battery common closed at 55¼ bid and 55½ asked.

Wall Street, December 17.

Westinghouse Gets the Third Avenue Contract in New York City.

The first announcement of the fact that the Westinghouse Electric and Manufacturing Company had secured the contract for the steam and electrical equipment for the new system of the Third Avenue Railroad Company, of New York city, was made in last week's issue of the ELECTRICAL REVIEW. The following additional particulars of this important deal have since been obtained.

The contract involves the expenditure of several millions of dollars, and covers the steam engines, boilers and entire steam plant, and the electric generators, rotary transformers, static transformers, switchboard apparatus, car equipments, and all of the other electrical apparatus required.

Mr. Albert J. Elias, the president of the Third Avenue Railroad Company, in speaking of this award, said that the officers and consulting engineers of his company had devoted several months to the subject with a view to the selection of the best apparatus and system obtainable, and of the electric company best qualified to undertake the work.

To meet the present and prospective requirements of the Third avenue system, it has been decided to erect on the company's property on 216th street a plant having a steam and electrical capacity of 64,000 horsepower, with the most effective equipment possible for economizing fuel and labor. It is expected that this station will not only be the largest, but the most complete and economical power plant in the world.

The many features of the mechanical and electrical engineering involved, all of which must operate together harmoniously, made it advisable that the work should be carried out under a single contract with the concern best qualified to do the work. It was felt that the experience of the Westinghouse company in manufacturing and installing the 5,000-horse-power generators at Niagara Falls, and its experience gained in other large power transmission plants, together with the experience of its associate interests in steam as well as electrical engineering, gave that company exceptional qualifications for the work.

Mr. Westinghouse, when seen in regard to the award of the contract to the Westinghouse Electric and Manufacturing Company for the electrical equipment of the Third avenue lines, said that the official statement issued by President Elias, of the Third avenue company, covered the matter fully.

Something over half of the contract will be for the steam plant, and the balance for electrical apparatus. The electrical apparatus will be manufactured by the Westinghouse Electric and Manufacturing Company at its works in Pittsburgh and at the works of the Walker Company in Cleveland. The engines will be built by the Westinghouse Machine Company of Pittsburgh, whose factory adjoins that of the Westinghouse Electric Company, and the erection of the steam plant will be in charge of Westinghouse, Church, Kerr & Company, general engineers and contractors of New York city.

The Westinghouse interests will expect to make this the most complete and satisfactory steam and electrical power plant in existence.

Large as the contract may appear to be, the company's facilities are now such that it can execute this contract and others of equal proportions without interference with its regular manufacturing operations.

Electrical Engineers in the War.

The 192d meeting of the New York Electrical Society was held at the College of the City of New York on Wednesday evening, December 14. Col. Eugene Griffin, colonel of the First Regiment United States Volunteer Engineers, made an address on "Ideas Underlying the Organization of the Volunteer Engineer Corps; the Work Accomplished by It in Porto Rico and the Opportunities of Future Usefulness." Mr. W. D. Weaver, late chief engineer of the U. S. refrigerating ship "Glacier," and F. W. Roller, late chief engineer of the United States gunboat "Nashville," also made addresses on the subject of electrical and engineering work in the navy during the war.

American Electric Locomotives for Paris.

The General Electric Company will supply eight electric locomotives and other equipment for the tunnel of the Paris–Orleans Railway in Paris. The system to be used is that of three-phase generators having rotary converters changing an alternating to a direct current at 500 volts. The General Electric Company some months ago secured a contract to supply 28 electric locomotives to the new Central London Underground Railway Company. A number of the locomotives have been built and are ready for shipment.

Important to Electrical Contractors and Companies.

Mr. William Walton, deputy commissioner of the Department of Public Buildings, Lighting and Supplies for the Borough of Brooklyn, New York city, has issued the following notice to electrical contractors and companies:

The Greater New York Charter, at Sections 575 and 580, imposes upon this department the duty of inspecting interior wiring and issuing certificates therefor. Before commencing work on any electrical installation in the Borough of Brooklyn, contractors should make application to the undersigned for certificates on forms provided for the purpose. This department will make the necessary inspections from time to time, and, if the work shall be found to be satisfactory, will issue certificates covering the same. Electric companies are requested not to make, and not to permit to be made, connection with any electric wiring or fixture for which the contractor does not produce a certificate from this department.

PERSONAL.

Mr. Lyman McCarty, former general eastern passenger agent of the Baltimore & Ohio Railroad, has received a deserved promotion, and is now assistant general passenger agent of that road. Mr. McCarty is a very popular railroad man, and abundantly deserves this advancement, and to him the ELECTRICAL REVIEW extends its cordial congratulations.

Mr. Francis E. Drake, of Chicago, director of machinery and electricity of the United States Commission to the Paris Exposition of 1900, spent last week in New York city interviewing prominent electrical gentlemen in relation to the Exposition. Mr. Drake's New York headquarters are in the Equitable Building. He anticipates a magnificent display from the electrical field; in fact, the trouble will be in providing the space already requested.

OBITUARY.

James Brown, superintendent of the Direct United States Cable Company in New York city for the past 14 years and associated with that company since its organization in 1874, died at his home, in New York city, after a brief illness, on December 17. Mr. Brown was born in Keith, near Aberdeen, Scotland, and was 47 years of age. He had been connected with submarine telegraphy all his life. He leaves a widow and two children. The funeral services were held at Mr. Brown's late residence in West 103d street, New York city, on December 20 and the interment was at Kensico Cemetery.

OUR CHICAGO LETTER.

The municipal electric lighting plant at Hinsdale, Ill., a suburb of Chicago, was wrecked this week by an explosion of the boilers.

Mr. R. J. Randolph, of the Sterling Arc Lamp Company, was a visitor in the city this week and registered at the Great Northern Hotel.

The Central Union Telephone Company, of Peoria, Ill., have voluntarily reduced their rates on all classes of service from 10 to 35 per cent. An independent company secured a franchise to install a plant there recently, but so far no work has been done.

The Chicago Electrical Association held its semi-monthly meeting in the Monadnock Building last night (December 16). Arthur V. Abbott, chief engineer of the Chicago Telephone Company, delivered an address on "Wireless Telegraphy." The following officers were elected: President, Thomas G. Grier; vice-president, J. M. Hollister; secretary, Cloyd Marshall; treasurer, Harold Alwart; directors, F. S. Hiscock, E. W. Jewell and H. Cochrane.

Joseph Leiter, the young Chicago millionaire, who caused such a flurry of excitement in the wheat market some weeks ago, has returned from the East, where he secured the controlling interest in the International Air Power Company, of New York, who control the Hoadley–Knight air motor. The company is capitalized for $7,000,000, and also own exclusive foreign rights in compressed air patents. In an interview, Mr. Leiter says that he believes that compressed air will, in time, largely supplant electricity as a motive power for street railways.

The 50-year extension franchise ordinance is causing an immense amount of talk and newspaper comment in Chicago. The interest in the contest, which promises to be a long and bitter one, is not only confined to Chicago, but all big municipalities are equally interested, for the question at issue seems to affect nearly every big city in the union. Mr. Charles T. Yerkes stands as champion for the railway company, and the mayor of the city, Carter H. Harrison, is leading the fight for the people. Public mass meetings are being held nightly, and the climax will be anxiously watched for by a large number of the city's population.

F. E. C.

Chicago, December 17.

Hon. Geo. O. Proctor, president of the Anchor Electric Company, of Boston, was recently elected mayor of Somerville, Mass., by a very large majority.

HIGH-VOLTAGE POWER TRANSMISSION.

READ BEFORE THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, OMAHA, JUNE 30, 1898, BY CHAS. F. SCOTT.

(Continued from page 357.)

Resistance and Reactance in the Circuit — Measurements were made with resistance between the generator and the raising transformer, then with reactance and then with neither resistance nor reactance. The results are shown in Fig 8, and indicate a different condition, depending upon the character of the circuit supplying the current. It was presumed that this difference arose from a modification of wave form of the electro-motive force applied to the line.

Wave Form and Loss—Measurements were made upon the wave form and the corresponding losses when different generators were used and different circuits were connected. In one test an armature giving nearly a sine wave was used which delivered current at 30 cycles. Measurements were made upon one circuit only, and then upon two circuits in multiple. The current and the loss are both given in Fig. 9. The wave form for no load and for both conditions of load are given in Fig. 10. The current taken by the two circuits in multiple is twice that to a single circuit. The variation from a straight line in one of the current curves is due to a change in wave form as the voltage is increased. The loss for the two circuits in multiple is about twice as great as for one circuit at low voltages, but it is less than that for one circuit at high voltages. Referring now to the wave form taken at high voltage, it is seen that the wave form for the two circuits in multiple has a lower maximum than that for one circuit alone. The reduced loss on the two circuits is undoubtedly due to the different wave form when both circuits were connected. The distortion of the wave form is due to the reaction which the leading current produces in the generator and transforming apparatus.

Wave forms were also taken on the slotted armature, giving 60 cycles. The wave forms are given in Fig. 11. The conditions are similar to those just described, in that a single circuit produces a wave having a much higher maximum than that produced when two circuits are run in multiple. The losses (which are not shown) bear the same general relation as that in the last case; namely, the loss with two circuits is greater at low voltage and at the high voltage is less than that on a single circuit

A wave form was taken upon the toothed armature both at no load and also when supplying current to one of the circuits. These are shown in Fig. 12. This wave differs radically from a sine wave at no load and is greatly distorted when supplying a leading current. In the no load wave the value of the fundamental is 72.5 per cent; the third harmonic, 21.6 per cent; the fifth harmonic, 4.8 per cent. The corresponding loss is given in Curve 1, Fig. 9. The distorted wave makes the Thomson wattmeter read too high, especially at the lower electro-motive forces.

"A series of observations were taken extending over a period of 33 days, to determine whether there was any connection between the loss occurring on the lines and the variations in weather conditions. Three readings were taken each day. They were, in addition to the wattmeter readings, readings for barometric pressure, temperature, humidity, wind direction and wind velocity. The weather observations were taken simultaneously at Ames and the King, using sets of weather instruments furnished by the United States Weather Bureau. The range of these observations is shown in a table given below, in which maximum and minimum refer to the maximum and minimum results obtained at any time during the 33 days over which the measurements extended:

Location.		Barometer.	Temperature Deg. F.	Humidity per cent.	Wind velocity miles per hour
Ames.	Maximum	22.19"	73.5	43 2	22
	Minimum	21.68"	56.3	7.1	2
King.	Maximum.	21.82"	62.0	42.5	21
	Minimum	19.81"	47.8	3.0	3

"If there was any variation in the loss on the lines for this range of weather conditions, it was so small as to be inappreciable. The results of all measurements taken during this work seem to confirm the fact that the only weather condition whatsoever which affects the loss to any practical extent is that of precipitation. The loss seems to bear some relation to the size of the particles precipitated, being greater for a fall of snow in which the flakes are large than one in which the flakes are small.

"In the power transformers used, the series reactance was comparatively small, because of the subdivision of the coils. A change in the condition on the line as regards loss occurred when the Weston wattmeter was placed in circuit. This was detected by measurement upon the Thomson wattmeter, both when the Weston wattmeter was in circuit and when it was not. Moreover, the lines hiss when the voltage is 55,500 and the Weston wattmeter is out of circuit, but when the Weston wattmeter is thrown into circuit the hissing ceases, although the voltage rises to 57,700. The hissing sound is a characteristic of high-voltage lines, and begins at the bend in the loss curves. It always accompanies luminosity of the lines.

"Along with this change there was another phenomenon not previously mentioned. This was a discharge which took place from time to time between the terminals of individual choke coils. The discharge would occur sometimes between the terminals of one choke coil and sometimes simultaneously on two or three of the choke coils. These discharges made considerable noise, sounding very much like a pistol shot, and could be heard at a considerable distance from the transformer house. As the choke-coil terminals are distant from each other about eight and one-fourth inches, it is not thought that this discharge took place through the air, but over the surface of the wood enclosing the choke coil. The discharge, however, left no mark on this surface. Simultaneously with these choke-coil discharges one could hear, if standing under the line some little distance from the transformer house, a slight snap which seemed to be a phenomenon rather of the whole line than of any particular spot in it. Sometimes there was a corresponding snap over the lightning arresters. As the lightning arresters make more or less noise at all voltages, this snap over them may have been present at all times, but in some cases not sufficiently well marked to be heard above the continued hissing of the lightning arresters.

"After the preceding results had been obtained, the two power transformers were connected up with their high-tension windings in series, the point of connection between them being grounded, and with their low-tension windings in multiple. With this arrangement voltage was impressed on one of the circuits, power being supplied by the smooth armature at 7,200 alternations. The voltage was run by means of the machine field to 90,000.

"As the power taken by the lines at this voltage overloaded the motor used to drive the generator, a span was cut out of the circuits at a little distance from the station, leaving about 500 feet of wire in them. The voltage was run up to 133,000 volts and held there for some minutes; but the current finally jumped from the outside terminal of each transformer to the iron, smashing the heavy glass tube with which these terminals were insulated."

The following is taken from Mr. Mershon's discussion of the results of his tests:

"There is evidently a certain critical voltage at which the loss occurring between wires begins to increase very rapidly; indeed, it seems as though there might be something of the nature of a polarization similar to that which occurs in the case of an electrolyte; that there is something of this nature in the case of air or other gases subjected to an electrostatic stress is well known, and it has been taken as an explanation of the fact that, in the experimental determination of sparking distances in air, a certain minimum potential is necessary to establish an arc, no matter how small be the sparking distance. Also, Varley has done some work on tubes containing gases. This work was done with a series of Daniell's cells yielding 300 to 400 volts. The voltage was impressed upon electrodes sealed into the tubes. He established the following facts: First, that each tube required a certain potential to leap across; second, that the passage for the current having been once established, a lower potential was sufficient to continue the current; third, if the minimum potential which would maintain a current through the tube be P and the voltage varied to P plus 1, P plus 2, etc., to P plus N, the current will vary in strength as 1, 2, 3, etc., N; P always meaning the lowest value at which the current will continue, and is less than that at which the current starts.

"If such a condition of affairs obtains in this case, the loss curves of the preceding sheets must be made up in two parts, one the loss over the insulators and cross-arms, the other the loss occurring through the air. The first part of the loss curve, up to or near the point where the abrupt bend begins, must be the loss over the insulators and cross-arms alone; beyond the point where such a bending occurs, the loss curve must be made up of a combination of the two losses referred to.

"If the action which takes place in air is similar to that obtained by Varley, we might expect that both (1) the position of the critical bend on the loss curve and (2) the law which the loss follows above the bend, would be affected by the form of electro-motive force wave impressed upon the line, for the former (1) must depend, not upon the mean square of the voltage impressed upon the line, but upon the mean square of that portion of the electro-motive-force wave which is above a certain critical voltage, and the latter (2) must depend upon the form of that portion of the electro-motive-force wave above a certain critical voltage because, as Varley shows, the minimum voltage at which this peculiar loss begins, differs slightly from the minimum voltage at which it will continue after the action has been established. If it were not for the latter consideration it would be comparatively easy to determine the equation for such loss, at least in the case of a pure sine wave, and it might be that there is a sufficiently small difference between the voltage at which this loss will begin and the voltage at which it will discontinue for such an equation to hold practically. That the loss depends upon the maximum value, if not upon the form of the electro-motive force wave, is shown by several of the loss curves in connection with their corresponding wave forms. This is particularly noticeable in one or two cases where the loss on two lines in multiple is less than that on one line, and although some of these comparisons

will have to be made between curves taken on the two different wattmeters and are, therefore, not strictly comparable, they may be compared after such correction as is mentioned below in discussing the wattmeters. In any case the curves are comparable, qualitatively, as regards the position of the critical point.

"It might be objected that the results are rendered questionable by the curves in Fig. 7. The curves were taken under presumably similar conditions, except that one was obtained by means of the Thomson wattmeter and the other by means of the Weston wattmeter. This discrepancy is attributed to a charging current passing through the shunt resistance of the Thomson wattmeter. That the amount of capacity current necessary to produce the discrepancy is small,

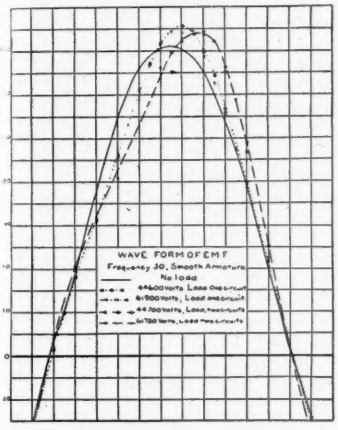

WAVE FORM OF EMF
Frequency 30, Smooth Armature
No load
44400 Volts, Load One Circuit
41900 Volts, Load One Circuit
44700 Volts, Load Two Circuits
41750 Volts, Load Two Circuits

FIG 10.—"HIGH-VOLTAGE POWER TRANSMISSION"—WAVE FORM OF ELECTRO-MOTIVE FORCE, SMOOTH ARMATURE.

appears upon the following considerations: In one case the loss obtained upon a circuit at 38,000 volts, when using the Weston wattmeter, is 90 watts, and under the same conditions, but using the Thomson wattmeter, the loss is 215 watts. The difference in the loss obtained by the two wattmeters is, therefore, 125 watts. The current is about 0.25 of an ampere. Now, 0.25 of an ampere, if in step with the electro-motive force, would give on the Thomson wattmeter at 38,000 volts a reading of 9,500 watts; therefore, the capacity current through the shunt resistance necessary to produce the discrepancy of 125 watts is 125 divided by 9,500 or about 1.3 per cent of the current in the shunt resistance. The shunt resistance has a value of 1,202,300 ohms; at 38,000 volts the current through it would be about 0.032 amperes; 1.3 per cent of this, or 0.00416 amperes, is that required to produce the discrepancy noted. In further support of this method of accounting for the discrepancy, the results obtained at different numbers of alternations using the Thomson wattmeter show a variation for different numbers of alternations of the losses below the bend in the loss curve, and which are thought to occur over insulators and cross-arms. There should be no variation in such loss for a variation in frequency.

"Any discrepancy occurring in the Thomson wattmeter by reason of a capacity current in its shunt resistance will be affected to a greater or less extent by change in the wave form.

"It is believed that all the phenomena connected with this work may be studied in a tube which has been partly exhausted. The work could then be done with comparatively low voltage and using direct current, which would much simplify the measurements. The contents of the tube might be partially rarefied air or other gas, as the action would undoubtedly be similar in all gases. With such a tube might be studied the law of variation in distance and form of electrodes, also in material and surface of the same.

"RÉSUMÉ AND CONCLUSIONS.

"It is undoubtedly true that the loss is made up of a loss over insulators and a loss between wires, and that the latter is the only loss worth considering.

"The loss between wires is not affected by any atmospheric conditions except precipitation. This statement, of course, must be taken as applying to such a climate as that in which the measurements were taken. The lines were seldom in fogs or clouds, and when they were, or when rain was falling, the moisture was of the purest. Near cities the loss would be undoubtedly much greater than that shown in these curves, because of the impurities both in solution in the moisture of the atmosphere and in suspension.

"There will be for a given transmission a certain economical voltage, because while an increased voltage, with a given line wire, will reduce the loss in this wire by decreasing the transmission current, it will also increase the loss between the wires.

"It is believed that attention to wave form is very important. The sine wave is undoubtedly the best as giving a stable form, and because of superior results with all kinds of apparatus. A flat wave would, of course, give less loss, but would not be stable, and as the nearest practical approach to a sine wave will not be perfectly stable but will still contain some harmonics, it will be of advantage to keep the series reactance of the transformers and generators as low as possible.

"It is believed that 40,000 volts is perfectly conservative and safe as regards loss between wires for any ordinarily good wave form, and in a climate such as that in which the measurements were taken; i. e., where the air and precipitated moisture are practically pure, 40,000 volts comes well below the bend in the loss curve even under the worst weather conditions.

"I can see no advantage of porcelain over glass, unless it be that of superior mechanical strength. The latter is rather a doubtful advantage. The ball from a heavy caliber rifle or revolver, such as are used in the western country, will smash any insulator, whether glass or porcelain. Porcelain offers a more tempting mark, being white. As to hygroscopic properties, no difference could be discovered so far as these measurements were concerned. It will make little difference under running conditions whether the insulator be hygroscopic or not, as the small amount of power necessary to keep the surfaces dry will be insignificant. I say under running

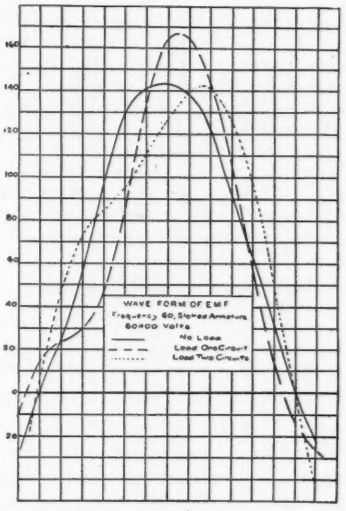


FIG. 11.—"HIGH-VOLTAGE POWER TRANSMISSION."—WAVE FORM OF ELECTRO-MOTIVE FORCE, SLOTTED ARMATURE.

conditions, because in starting up a 'cold' line there is danger of breakdown if current is put on suddenly at full value, instead of being raised gradually. As far as the resistance to piercing is concerned, glass is just as good, practically at least, as porcelain. It needs no electrical test to pick out a good glass insulator, which is one advantage of glass over porcelain.

"To sum up, glass insulators are cheaper, lighter, more easily tested and less likely to be shot at than

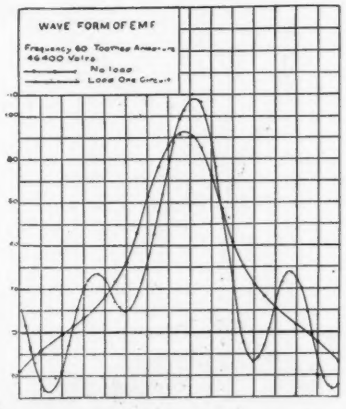


FIG. 12.—"HIGH VOLTAGE POWER TRANSMISSION."—WAVE FORM OF ELECTRO-MOTIVE FORCE, TOOTHED ARMATURE.

porcelain; on the other hand, they have less mechanical strength.

"In every case, in my experience, where a breakdown has occurred, it has been on a cross-arm which was 'wind shaken' and 'weather cracked,' the current following the cracks. This leads to a curious result. The mark of the current will be on the surface of the arm for five or six inches, then disappear from the surface altogether for some inches, then reappear, etc. On cutting open the arm one sees how the current has followed the best path, dodging in and out. Rain and moisture probably settle towards the cracks, carrying salts from the body and surface of the wood. This forms a path of low resistance, especially in wet weather. For this reason I have in the plant of the Colorado Electric Power Company taken particular pains in treating both pins and cross-arms. The cross-arm treatment is such as fills all cracks and fissures as a section of the wood shows.

"This report would be incomplete without an acknowledgment of the assistance rendered in the work by the engineering force of the Telluride Power Transmission Company, headed by Mr P. N. Nunn. Especial credit should be given Mr. A. L. Woodhouse for his faithful work and constant perseverance in the face of great discouragement."

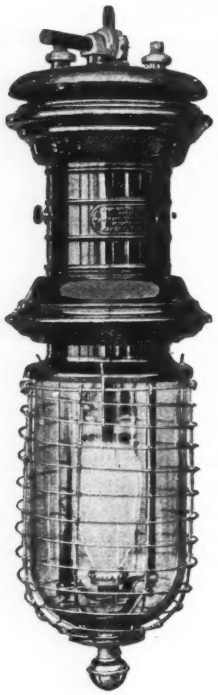
(To be continued.)

The Rhine a Rival of Niagara.

The important results which have been realized in this country and Canada through the utilization of the Falls of Niagara for the production of electricity, are about to be achieved in Switzerland, where the Rhine will soon become a rival of Niagara as an electrical agent The necessary works were commenced some time ago and are now rapidly nearing completion. The electric force that will be thus drawn from the waters of the river will be somewhere in the neighborhood of 16,000 or 17,000 horse-power, and will be supplied by 20 turbines of 800 horse-power each. The greater part of this immense force will be in the hands of one or two companies who will employ it to their own individual benefit, and to the exclusion of the general interest of the public. At the same time that the hydraulic works necessary for the utilization of the waters of the Rhine in the production of electricity are being carried out, the erection of a large factory for the manufacture of aluminum is in progress. This factory will employ 2,000 horse-power and will be the most important of its kind in Switzerland. The aluminum industry has lately assumed considerable importance in the country which hopes to become the rival of the United States in the manufacture of this article. The Rhine will also furnish electric power for the Frich-Aaran Railroad, the work in connection with which is now well under way. This utilization of the Rhine for electrical purposes will not only transform the existing condition of certain important industries in Switzerland, but will open up an industrial future the greatness of which can hardly be at present appreciated.

An Enclosed Marine Arc Lamp.

Adequate electric illumination of wharves, docks, warehouses, dry docks, shipyards, with their adjacent iron-working shops, and the holds of vessels, while loading or discharging,



AN ENCLOSED MARINE ARC LAMP.

demands a type of lamp somewhat different from that used for street or store lighting. It must be strong, compact and durable, or it will not withstand the hard usage which such service will naturally give it; it should give a large volume of clear, white light, which will not dazzle the eyes of the workmen nor throw heavy shadows in already obscure corners; it should require little attention, and be so simple that it can be attended by an average lamp-trimmer; lastly, it should require trimming, not daily, but only at long intervals.

A lamp which meets these requirements is the marine enclosed arc lamp, manufactured by the General Electric Company. It has been made the object of special design to adapt it to marine usage. The mechanism is compact, simple and reliable, and is protected from injury or the effects of the weather by a stout metal casing. It is only necessary to renew the upper or long carbon once in 100 to 150 hours, the lower carbon, after the first run, being the unburnt remainder of the upper carbon. With open arc lamps, it was necessary to renew the carbons daily. The outer globe shown as of clear glass in the illustration is cylindrical in shape, of thick glass and protected from injury by a heavy wire guard. The globe can be lowered by a half turn of the thumb-screw at the side, and when pushed back in position is automatically and securely locked. The lamp is only 28 inches long. It can be carried from place to place if necessary, and hung by the metal ring at the top to any convenient hook, or may be permanently fixed in place like an ordinary arc lamp. The lamp can be used on a 110-volt circuit and can be adjusted for 4, 4.5 or 5 amperes, the latter being the standard. Many of these lamps have been installed in locations such as those mentioned above, and, it is said, have in every case given very satisfactory service.

Incandescent Lamp-Holders.

In the accompanying illustrations are shown several types of lamp-holders, which are adjustable to various positions, manufactured by the O. C. White Company, of Worcester, Mass. In Fig. 1 is shown a fixture to be attached to the ceiling; in Fig. 2 one designed as a pedestal fixture, and in Fig. 3 a bracket fixture to be attached to the wall. These types are all equipped with flexible joints, which render it possible to bring the lamp into any desired position, where it remains fixed. No attention is required for the fastenings. The manufacturers claim that a plant equipped with these fixtures usually requires about two-thirds as many lamps as in the old way, as the lights can be used to

FIG. 2.—PEDESTAL INCANDESCENT LAMP-HOLDER.

greater advantage. These devices are supplied in a number of finishes suitable for the surroundings of the place in which they are to be installed. On application the company will supply price lists and circulars describing its line of manufactures.

The Electrical Trade in Brazil.

A traveling representative of the Philadelphia Commercial Museum, who has recently returned from Brazil, has made the following re-

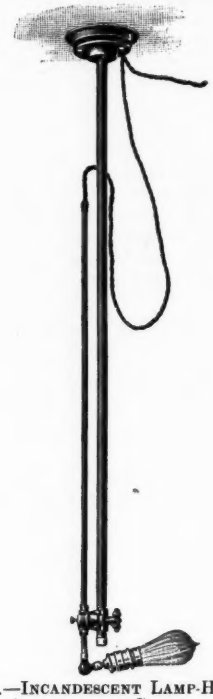


FIG. 1.—INCANDESCENT LAMP-HOLDER ATTACHED TO CEILING.

port on the trade in electrical goods in Brazil:

"The electrical goods trade of Brazil is growing by leaps and bounds, it being only a few years ago that electrical trams, lighting, power, etc., were unknown in any part of the country. Now almost every town and city within 300 miles of the coast is either lighted by electricity or has the project under consideration. Many of the mining companies and cotton-cloth mills through the interior have plants now in operation, supplying them with both light and power. Several of the large plants have come from England.

FIG. 3.—BRACKET INCANDESCENT LAMP-HOLDER

"As the Brazilian Government does not collect statistics of her import and export trade, it is impossible to state the volume of the imports of the electrical apparatus and supply trade. It is, however, well known that they are large and constantly growing, and also that the trade is controlled as regards supplies almost exclusively by England and Belgium. The United States comes in for a fair share of the trade in electrical machinery.

"Arc and incandescent lamps, fittings, carbons, wire of all kinds, electric bells, batteries, electricians' tools and gloves, zincs, sal-ammoniac, etc., are in demand in the towns along the line of the Central Railroad between Rio and Sao Paulo, and Rio and Bello Horizonte, as these towns at present rely on the Rio merchants for their supplies.

"Bello Horizonte, the new capital of the state of Minas Geraes, is a growing town of at present about 30,000 inhabitants, and is located in the heart of the mining and cotton-mill district and practically at the end of the main line of the Central Railroad. It is therefore in a position to supply with electrical goods not only the mining and cotton-mill companies, but the towns of Sabara, Sete Lagoas, Curvello, Caethe, Ouro Prete (the old capital), La Fayette and about 10 other small towns on the line of the railroad between there and Juiz de Fora, that are lighted with electricity.

"At Juiz de Fora another electrical plant is installed, and here another agency for sundries would do well in supplying not only Juiz de Fora and the adjoining town of Marianna Procopio, but also the towns on the lines of the west of the Minas and Laopoldina railroads, which intersect the Central Railroad at Sitio and Areal, both near here.

"Along the line from Rio to Sao Paulo are also many towns in which it might be advantageous to have agents. A competent salesman, familiar with the Portuguese language, traveling through this section could do wonders in the way of securing orders and appointing responsible agents.

"This may also be said of nearly all the interior cities, as attention so far has seemingly been paid only to the large cities on the coast, and even there not to the extent the trade possibilities deserve."

Washington Car Barn Burned.

The Eckington & Soldiers Home Railway barns, at Washington, were burned on Saturday night, December 3. The loss is estimated at $65,000, largely covered by insurance. About 30 cars were consumed.

Some Interesting Points in Arc Lamp Construction.

The splendid advance made in the last year and a half in the realm of arc lighting makes the present status

FIG. 1.—UPTON CONSTANT POTENTIAL ARC LAMP.

of arc lamps one of considerable interest. It is the idea to show in this article in a brief way the character and construction of the arc lamps now being made for the various currents and different adaptations, and we have selected photographs showing a number of the representative forms now manufactured by the Standard Thermometer and Electric Company, Peabody, Mass., as illustrating well these ideas. It may be mentioned, incidentally, that this company are now having a very large demand for the Upton "Midget" lamps, the name which they give their arc lamp, and at the present time they are sending large orders into the West and the South, and a number of important consignments on special orders to various European countries.

Fig. 1 illustrates the plain cover for either indoor or outdoor service. This is the lamp for a constant potential current, though this mechanism is made in several styles of cover, or the cover may be adapted for any of the other currents except that for the alternating.

In Fig. 2 is illustrated the inner mechanical construction. It will be noticed, if one will contrast with one of the original forms of arc lamps, how simple and compact the recent developments are in comparison to the original conception. The mechanism for the 220-volt circuit constant potential lamp is similar, as will be seen by a reference to Fig. 3 to that of the one to which we just referred, with the exception of a change in the magnet and construction of the clutch rod. This lamp is de-

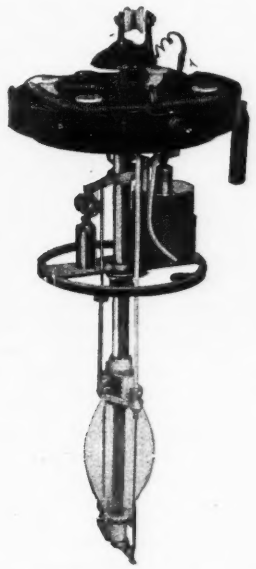


FIG. 2.—MECHANISM OF UPTON CONSTANT POTENTIAL LAMP.

signed to take from two to three and one-half amperes, with approximately 150 volts across the arc. This form of lamp may be operated independently, and it requires the same

FIG. 4.—UPTON ENCLOSED ALTERNATING LAMP.

wattage consumption at two and one-half amperes as the 110-volt lamp at five amperes.

Fig. 4 shows the general exterior appearance and construction of the Upton "Midget" enclosed lamps for alternating current. On circuits of 16,000 alternations, the lamp operates direct from secondary current of from 100 to 125 volts, without any transformer, economy coil or resistance.

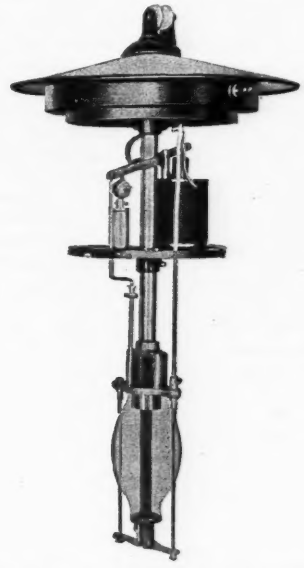


FIG. 3.—UPTON 220-VOLT CONSTANT POTENTIAL LAMP.

The magnet of the lamp is its own transformer. The lamp draws an arc of 80 volts at five to six amperes, having an average consumption of 380 to 500 actual watts per hour. For

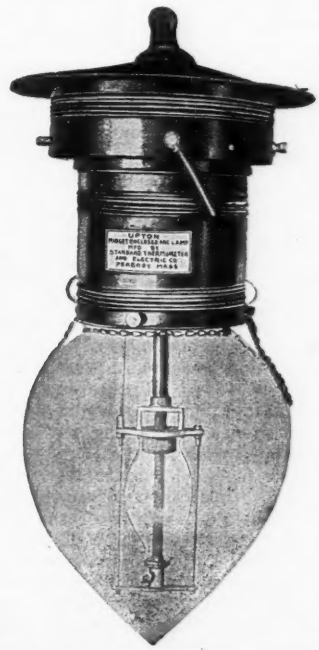


FIG. 5.—UPTON DIRECT-CURRENT POWER AND RAILWAY LAMP.

better regulation, the lamps for 7,200 alternations have an impedance coil provided. The illustration shown herewith is for inside service, though this same lamp is made with the hood in different designs for outside service. The electricians of the Standard Company say that careful tests have proved that the best results are obtained from the use of one solid and one cored carbon, this combination depositing the least dust, and overcoming, to a great extent, flaming of the arc and the violet rays obtained by the use of two cored carbons, or short arc with consequent shadow by use of two solid carbons.

Illustrations Figs. 5 and 6 show the complete construction and the inner mechanical details of the Upton Midget lamp for direct current power or railway circuits to be connected two or more in series with at least 90 volts per lamp. Other special designs are also adapted for constant-current, high-tension, series circuits.

During the past year many important tests and experiments have been conducted in the laboratories and shops of this company by Mr. J. H. Hallberg, and it has been the aim to develop every possible advantage in the Upton product for arc lighting.

The Inland Telephone and Telegraph Company has decided to put all its wires under ground at Spokane, Wash., at a cost of about $100,000.

A Wise Suggestion from a Great Journal.

One whose occupation or inclination leads him to take an interest in electrical matters will do well to add the

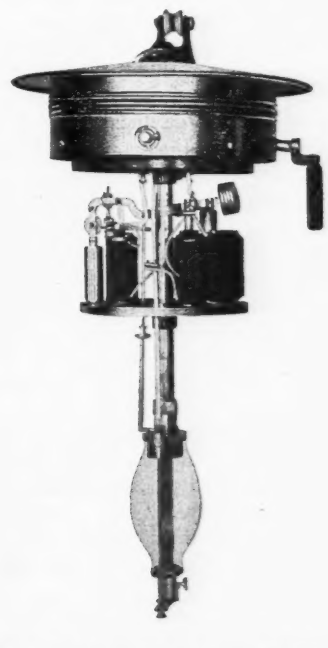


FIG. 6.—MECHANISM OF UPTON DIRECT-CURRENT POWER AND RAILWAY LAMP.

ELECTRICAL REVIEW to his list of periodicals, if he is not already a reader of that publication.—*Globe-Democrat, St. Louis.*

LONG-DISTANCE TRANSMISSION OF ELECTRIC POWER.

BY PROF. GEORGE FORBES, F. R S., M. INST. C. E., BEFORE THE SOCIETY OF ARTS, LONDON, NOVEMBER 23.

This subject has been much talked about, but little has been done, and, even at this moment, there are few people who realize what a vast field there is in this way for investment of capital on a sound commercial basis. Hitherto, people have been appalled at the capital required for copper conductors.

In the present paper I bring forward nothing new. I use the methods which have been used for shorter distances, and I do not propose to suggest the use of electric pressures which have hitherto been considered unattainable. In all cases it is assumed that the power is generated by a waterfall driving a turbine, which rotates a dynamo machine. The electric pressure may be raised by transformers. It is then carried by bare copper conductors to a point perhaps hundreds of miles distant; the pressure may there be lowered. The current is then passed through an electric motor which drives stamps, or mills, or pumps, or hoists, etc.

In this paper there is no time to devote to consideration of different systems or kinds of machinery, or of replacing copper by aluminum. It is a plain, unvarnished tale of the ordinary methods in use, extended to somewhat greater distances.

During the progress of the electric works at Niagara Falls, attention was much given to the economic problems involved in the transmission of electric energy to a distance. But in that case, clearly the following financial conclusion ruled the conditions: It is always more profitable to bring the works requiring power to the electric source of power than to transmit the power to a distance, provided—and in most schemes this is a large IF—you can find consumers to come to your locality. At Niagara this seemed likely, and, consequently, distance transmission beyond 25 miles was considered undesirable in the first instance.

I am here as an advocate of very distant transmission in all cases where it pays, and I know that it will yield a splendid return in many cases that have come under my notice. In all cases it would pay if there were a demand for the power at suitably high rates.

TO GOLD MINERS AND OTHER USERS OF POWER.

Of all industries to which it is applicable, gold-mining is the one which has come mostly to my notice as wanting a continuous supply of power day and night, and often without any economical means of getting it except by electric transmission. In these cases it will often be profitable to the gold miner to pay a high price for his power.

The distances with which I have had to deal go up to 250 miles in India, New Zealand and Egypt, and if the Rhodesia mines show generally such returns as the Geelong and Selukwe mines have done, I have shown that the power of the Victoria Falls may be economically transmitted in some cases to 500 miles, and pay well.

Waterfalls will be valuable assets in the future. At present, the difficulty of using their power generally lies in the fact that there is no demand for power in the neighborhood. Some industries, like those connected with aluminum and carbide of calcium, are ready to go considerably out of their way to plant their works near a source of power. There are not many such industries.

In 1893 I sat on a committee appointed by the Indian Government to see whether the water-power, incidentally created by the Periyar irrigation works, could be used for making aluminum electrically out of the corundum found in the neighborhood, and for other purposes. We found that power could be generated very cheaply, but that the corundum was not suitable, and no other important demands for power were brought to our notice. Years afterwards, I found that the Mysore, Kolar and other gold mines could easily be reached by the power and save great cost in coal. Here we have a transmission of 250 miles which will pay well if the mines are likely to continue producing gold as they have done.

Another specially favorable case of gold mines is in New Zealand in the North Island. The Waihi mines already work their mills by electrical and water-power, but there is no adequate supply of water in Summer. At many of the other mines there are no roads, and power can not be obtained. In 1896 I was asked to explore the Waikato River, in order to find the best site for developing power to be transmitted to all the gold mines on the Coromandel Peninsula near Auckland. I finally settled on the Haka Falls, near the center of the island, with a transmission line of from 180 to 250 miles, 20,000 horse-power being generated to supply not only all the gold mines but every freezing works and factory on the North Island. I spent six weeks on the survey of sites for the works, and furnished plans which would already be executed, except for what I must call the dog-in-the-manger policy of the government. The site was peculiarly favorable.

To take another case of gold mining. I was engaged in 1895–6 on a project without water-power and a transmission of 300 miles as a maximum. The Coolgardie gold fields are so far from a port that coal is very expensive, and water for the boilers could hardly be obtained. I found that it was actually more economical to generate power by steam engines at the coast, where coal and water were available, and to transmit power all the distance electrically, rather than to transport coal which was otherwise a necessity in all cases as well as water in many cases. In this case the miners were prepared to pay as much as £180 per annum for the horse-power.

In 1894, before I had completed the first electric works at Niagara, I was asked by letter from Johannesburg whether it would be possible to transmit power from the Victoria Falls, on the Zambesi, to all the gold mines in Rhodesia, varying from 350 to 500 miles, distance. At first I was inclined to throw the letter into the waste-paper basket. No one, up to that date, had, to my knowledge, seriously considered the financial aspects of so distant a transmission of electric power. But the letter required an answer, so I sat down to work out and quote some figures which should show the absurdity of the scheme. I had been supplied with maps and costs of fuel, etc., and in a short time I found, to my astonishment, that, if the facts were as stated, the scheme was financially and electrically a sound one. I was assured that at least 10,000 horse-power would be required at the mines, and that from £70 to £100 per annum would readily be paid for the horse-power. Upon this I was asked to go to South Africa to negotiate with Mr. Cecil Rhodes and Dr. Jameson for a concession. They both appreciated the value of the enterprise to the country, and prepared a draft of the concession, which was only awaiting the sanction of the Chartered Company's board when the Jameson raid and the Matabele rising closed negotiations. Here is a case where, if there be really good gold mines, it will pay handsomely to transmit electric energy a distance of 500 miles, provided the surveys of the falls prove as satisfactory as the photographs do, and provided the fever is not an insurmountable obstacle.

At this stage let me point out to those unacquainted with the difficulty of obtaining power at some gold mines, that £100 per annum for each horse-power continuously delivered would readily be paid in many cases. Broadly speaking, the power required for rock-breakers, stamps, etc., may be taken as being such that one horse-power mills one ton of ore per day. The value of the gold is, say, £3 or more per ton in a rich mine. I am not speaking of soft conglomerate like the Rand ore, where one horse-power mills two or three tons per day, but hard quartz. Now, when I speak of £100 per annum for a horse-power, this, at the rate of one ton a day, means 5s. 5d. per ton of ore for milling expenses. There are plenty of places where they would pay double this.

You have now heard of a number of cases where gold mining can be assisted by long distance transmission of electric power, for which I have worked out plans and estimates. There are hundreds of other cases about which I could not speak with the same authority.

But while I expect that gold mining is the principal industry to be benefited, there are many others, the chief requisite being a continuous demand for power day and night. This is met by electro-metallurgical processes, but these can generally be brought to the power. It also includes irrigation, which in some countries wants power day and night, and, to a certain extent, throughout the year.

The quantity of water pumped does not need to be perfectly constant, and this enables intermittent demands for lighting, railways and factories, to be met by slight variations in the pumping. Thus the plant is always fully at work and earning its dividend.

In speaking these words I am naturally thinking of the utilization of the Nile cataracts, upon which I have been engaged during the years 1897–8. My report on this subject is in the hands of the Egyptian Government, and is their property; but I am not divulging secrets when I tell you that the electric lighting of Cairo could be done cheaper by power generated at the first cataract than by steam engines at Cairo. The distance is 400 miles as the crow flies. Do not imagine that I propose lighting Cairo immediately in this way. The government has far more important uses for the power, not only in the irrigation of the country as it is, but still more for the perennial irrigation which will be so much extended when the great reservoir designed by Mr. Willcocks, Sir William Garstin and Sir Benjamin Baker, shall be completed by Mr. John Aird. You may take it as certain that before long the cataracts will be harnessed and forced to assist in developing not only Egypt proper but the Soudan, and specially the Dongola province up to the fourth cataract, which, with efficient irrigation, may become the most fertile country in the world.

Higher up the Nile, I have not traveled or made surveys, but I notice that Sir William Garstin is undertaking a journey to Khartoum and the Blue and White Niles to determine the value of the country there. A time will doubtless come when the Murchison and Ripon Falls will also be turned to account.

I trust that I have said enough to lead the users of power in certain industries, and especially gold miners, to see that it is well worth their while to look into the relative costs of steam and electro-hydraulic works, even when the transmission is for a distance of many hundreds of miles; and it will be seen that many a gold mine hitherto considered worthless because of the cost of power will be valuable if there be water-power available within a few hundred miles.

I will now speak to the financiers

who may think of taking up electric transmission.

TO FINANCIAL MEN.

The financiers in the city of London or elsewhere, who enable the projects of engineers to be carried out, even when they possess no technical knowledge, have a wonderful instinct by which they know the important points to be certain about before supporting a scheme with their money. Erroneous opinions on the engineering points may for a time prevail, but not for long.

Many examples of this insight might be given, but let us confine the matter to long-distance electric transmission. I will give you four objections which are always raised:

1. "Has electric power ever been carried to such distances as you speak of?" The answer is "No." But electrical practice is advancing by strides. In 1882, at Munich, Marcel Desprez earned great credit for transmitting electric power 35 miles and getting a return of 25 per cent. But, in 1891, 70 per cent efficiency was obtained between Lauffen and Frankfort, the distance being 108 miles.

2. "Are you sure that no new electric difficulties will arise when you go beyond the 108 miles of transmission, which has been accomplished? The answer is, "We are sure of this from the tests made at Frankfort." [Only one difference between short transmissions and the 108 miles from Lauffen to Frankfort was found to exist, and it had been anticipated by me in preparing the Niagara works. In 1892 I laid it down as essential for the works at Niagara, in order to be prepared for long-distance work and for other reasons, that the frequency of the alternations should be as low as the construction of a good dynamo would warrant. In 1894 the tests at Lauffen-Frankfort were published, showing that without this low frequency no good efficiency could be got from the long-distance power transmission owing to the great self-induction of the line.]

3. The financier again asks, "Are not the losses by leakage on a long line insurmountable?" The answer is, "There is hardly any loss by leakage. There is loss of power used up only in warming the transmission lines." But this loss can be calculated accurately, as in those cases where the wasted power costs little enough we are glad enough to waste it if it saves copper, which is the great cost.

4. The business man then asks, "Well, but if you allow a great loss of current in transmission, do you not require an enormous quantity of copper to carry the extra current which you have to generate?" The answer is that this is perfectly true if you allow the losses to be too great, but up to a loss of 50 per cent on the transmission line you are always saving copper by having greater losses on the way. In fact, every engineer who has made a serious study of long distance transmission will bear me out when I say that the cases in which electric transmission will pay can be clearly differentiated from those which will not pay, and the whole question is principally one of £ s. d. Also, that all engineers will agree as to what is the principal item of expenditure; viz., the cost of copper under the conditions of existing practice. Improvements may reduce this cost, but can not increase it; hence the financier may be very sure of the data of expense, and, if he can be equally well assured of the data of revenue, he has before him everything required for forming a sound judgment. Let us take three cases.

1. Suppose a water-power is utilized for distant transmission of 200 miles to a gold mine where transport is difficult and the ore rich. Suppose that the miners are ready to pay £100 per annum for each horse-power delivered continuously to the stamps, etc. (I am taking what may be looked on by some as an extreme case, but there are many such places in the world); suppose that it is a gold field employing only 1,000 horse-power continuously; the gross income is then £100,000 per annum. This is a large sum and will warrant a very large capital expenditure.

Now, if it is a case in which 20,000 volts of electric pressure may be used, less than 900 tons of copper is required, after 50 per cent has been added for self-induction, giving an inefficiency (inverse of efficiency) of only 1.4. Thus, 1,400 horse-power will have to be generated at the waterfall end of the transmission line for 1,000 horse-power delivered at the other end, the gold mine. The hydraulic and electric machinery are not likely in a favorable case, even with costly transport, to exceed £14,000. The working expenses are small, and clearly the great thing to be considered is the cost of copper. This might amount to £80 per ton of copper laid, or £72,000. Very likely the whole cost would be under £100,000, which, with a maximum possible annual expenditure of £20,000, would produce a revenue of £80,000 per annum, or 80 per cent. I am sure that actual cases exist where this might be done.

2. If the distance were 400 miles, all other things remaining the same, the only serious difference is in the cost of copper, which rises to £288,000; and taking £32,000 for the other expenses, the capital expenditure is £320,000. If the annual expenses were £20,000, which seems impossible, the net income is £80,000 or 25 per cent.

3. Suppose the distance still 400 miles, and all other things remaining the same, but only £50 being paid per annum for the horse-power; here we have still £320,000 of capital expenditure, and a net income of £30,000 for 1,000 horse power delivered, or nine per cent.

Of course, it is understood that while cases can occur where these figures apply, each case must be examined on its merits.

Looking at the last case quoted, the delivery of 1,000 horse-power at 400 miles, using 20,000 volts (or 200 miles with 10,000 volts), the financier would say nine per cent was not good enough for such a venture. I will now show how he may get 40 per cent, using the same machinery, the same copper, and the same annual expenses. This leads me to say a few words to the great copper companies.

TO COPPER MERCHANTS.

I have now the pleasure to lay before you a simple financial transaction which copper merchants or others would willingly make, and which may avoid the huge capital hitherto required by those who would transmit the power, and will increase the dividends on money spent on the transmission. What I propose is to divide the capital account into two parts, ordinary stock which may be looked upon as speculative, and bonds on the copper which would be as sound an investment as could be desired.

Taking the last case mentioned, the capital charges are:

3,600 tons of copper at the extreme value of £75 a ton	£270,000	
Putting it in place at £5 a ton	18,000	
		£288,000
Hydraulic and electric machinery, etc.		32,000
Total capital required		£320,000

Most of this capital is required for copper which may be taken away if the company fails, and is an absolutely safe security.

The value of the copper is	£270,000
Cost of removal (uncalled capital)	18,000

On the £270,000 a mortgage may be raised, and 4 per cent ought to cover the chances of a change of market value. Thus we have—

Annual payment on mortgage	£10,800

All we have done is to raise a mortgage on the best possible security. This might be done by the copper companies, who often have too much material in stock not paying interest, or the money could easily be obtained from independent capitalists. Let us now see what difference this has made upon the balance-sheet. The capital charges are:

Putting copper in place		£18,000
Hydraulic and electric machinery		32,000
		£50,000
Annual gross receipts—1,000 horse-power at £50		£50,000
Less annual expenses	£20,000	
Mortgage on copper	10,800	
		30,800
Annual net receipts		£19,200

or almost 40 per cent.

By this simple transaction we reduce the total capital required by the transmitters of power from £320,000 to £50,000 for 1,000 horse-power delivered, and we have increased the rate of interest from nine per cent to 40 per cent, which ought to satisfy most people.

This scheme I have laid before the manager of one of our largest copper companies, and he entirely approved of the general lines.

Before leaving this part of the subject, I wish to make it quite clear that none of the figures which I have given up to the present must be taken as applicable to every case that may arise; the cost of developing the power at a waterfall depends so much upon the height of the fall, accessibility, etc., that no kind of an idea can be given of the cost without some data to go upon. The costs used in the above calculation are over the mark for the most favorable cases, and the cost of copper is also too high. Another factor is the size of the works. The larger the scale the smaller is the relative cost of works.

All that I have tried to make clear is that if there be a large and continuous demand for the power, and if the value of the mechanical power to the gold miner or others is great, the distance to which it can be transmitted with financial success is not limited to 100 or 200 miles.

TO ENGINEERS.

Up to the present date, financial men have not realized the value of long-distance transmission. Engineers, too, have been so much engaged with electric lighting and traction that few have devoted much time to its study. The last nine years of my life have been devoted almost entirely to electric transmission and the last four years to very distant transmission.

At present, there exists no printed tables for facilitating calculations, such as civil engineers possess in other branches of the profession. In the case of electric transmission, every engineer must prepare his own sets of tables and curves to work from. I have been compelled to work these out for myself in various units. In England, we use miles, tons and pounds sterling. In America, the units are 1,000 feet, the pound avoirdupois, and the dollar. In Egypt, the metric system prevails. The flow of water, too, must be taken in cubic feet per minute, gallons per day, meters per second, the Californian "miner's inch," or the New Zealander's unit, which is called a "head."

(To be continued.)

Exciting Thought on a Grave Question.

[*From the New York Times*]

A correspondent of the ELECTRICAL REVIEW now proposes a scheme, however, which, whether hopeful or not, is at least interesting. He says that for the money which was spent with such poor results after the last storm, the city could have obtained 100 electric traction engines, each capable of towing six or eight ordinary loaded carts at a rapid rate. Half a million dollars would provide enough for these machines to do the work of 5,000 or 6,000 horses, and so obviate the chief difficulty that arises in these emergencies. As much more would purchase carts enough to permit of continuous loading, and the hauling could be done as fast as the carts could be filled. He even thinks that electric devices to do the loading could be made, and then not only would a 10-inch snowfall be removed in a few hours, but large amounts of public money would be saved. He says, too, that the electric automobiles could do municipal work of many kinds all the year round. This ingenious person may or may not have motors to sell, but his ideas have at least the merit of exciting thought on a grave question.

ADVANCE INFORMATION

Increase of Capital.

ST. JOSEPH, MO.—The Columbia Electrical Company has increased its capital stock from $2,000 to $6,000.

DANVILLE, ILL. — The Danville Telephone Company has increased its capital stock from $25,000 to $50,000.

KINGSTON, N. Y. — The capital stock of the Colonial City Traction Company, of this place, has been increased to $250,000.

New Incorporations.

SCHENECTADY, N. Y.—The South African General Electric Company has been incorporated, with a capital of $50,000, to deal in electrical apparatus, machines, engines and mechanical devices, and to construct works and plants involving their use in the United States, South Africa and other foreign countries. The directors are S. D. Greene, Henry W. Darling, D. Mazent, J. R. Lovejoy and M. F. Westover, of this place.

NEW YORK, N. Y.—Paragon Fan and Motor Company has been incorporated, to manufacture electric fan motors; capital, $2,500; directors, James P. Williams, of 39 Cortlandt street, New York city, and two others.

Electric Light and Power.

NEW YORK, N. Y.—The Manhattan Lighting Company has been incorporated, with a capital of $250,000, to manufacture and supply gas and electricity for lighting, heating and power purposes in New York and Westchester counties. The directors are Henry D. Brenner, of New York city; H. E. Bowen, of Brooklyn, and Henry P. Keith, of Hempstead, L. I.

GREENUP, KY. — The Greenup Light Company, of Greenup County, has been incorporated; capital stock, $5,000; incorporators are Charles Schmutz, J. E. Pollock and R. E. L. Wilson.

NEW ORLEANS, LA.—The Merchants' Electric Light and Power Company have awarded the contract to the Western Electric Company, of Chicago, for the erection of their plant. The work will be commenced as soon as the material is on the ground and will be pushed with vigor. The following board of directors have been elected: M. Ber, president; James Simon, vice-president; E. W. Goldschmidt, secretary and treasurer; C. D. Crandell, A. McEwen, Julian Cohen and E. H. McFall.

WILLIAMSPORT, IND.—The Williamsport Water and Light Company has been incorporated with a capital of $10,000; directors, J. H. Brown, B. O. Mayer and George Mayer.

TIMMONSVILLE, S. C.—The city will establish an electric light plant and will receive prices on machinery. Address D. H. Traxler, chairman committee.

SWEDESBORO, N. J.—The Swedesboro Light, Heat and Power Company has been incorporated by Charles D. Lippincott, Henry M. Mitchell, Thomas B. Turner, John C. Rulon, Benjamin F. Lawrence and James J. Davidson; capital stock, $25,000.

New Telephone and Telegraph Companies.

HINCKLEY, ILL.—The Northern Illinois Telephone Company has been incorporated; capital, $10,000; incorporators, F. A. Graves, M. D. Patten, F. B. Patten.

WINCHESTER, KY.—A new telephone company is to be established here.

FRANKFORT, KY.—The Flemingsburg & Myers Station Telephone Company, of Fleming County, has been incorporated; capital stock, $600; incorporators, J. B. Sherwood and others.

WEST UNITY, OHIO—The Citizens' Telephone Company, with a capital stock of $5,000, has been incorporated.

SHARON, PA.—A telephone company, composed of capitalists of western Pennsylvania, is being formed here to compete with the Bell Telephone interests. R. H. Adams, of Baltimore, is at the head of the project. The Citizens' Telephone companies, of Mercer and Lawrence counties, will be absorbed and the lines extended to Franklin, Oil City, Meadville, Erie and other cities in this part of the state.

New Electric Railways.

HARRISBURG, PA.—The Allentown & Slatington Street Railway Company has been incorporated at the State Department, with a capital stock of $200,000.

CHATTANOOGA, TENN.—The Lookout Mountain & Lula Lake Railway Company has applied to the commissioners of the corporation of Lookout Mountain for a franchise on a number of thoroughfares for the purpose of building electric lines to reach the most popular points on the mountain.

WINCHESTER, KY.—The City Railway and Transfer Company has been incorporated, with $2,000 capital stock. J. L. Brown, G. W. Adams and Rufus Seile are the incorporators.

CADIZ, OHIO—A project is on foot to construct an electric railway between Cadiz and the Twin Cities. The line would be 22 miles in length, and will cost $100,000.

PINE BLUFF, ARK.—The Pine Bluff Electric Light and Street Railway Company has been incorporated. The incorporators are Thomas L. Chadbourne, Jr., Henry C. Wood, attorneys, of Chicago; H. H. Hunn, Sam M. Taylor, Peter P. Byrd, Jeff Hicks and Sebastian Gesireiter, all of Pine Bluff. Officers have been elected as follows: Jeff Hicks, president; Thomas L. Chadbourne, Jr., vice-president; H. H. Hunn, secretary and treasurer. The board of directors is composed of the above officers and Henry C. Wood, Sebastian Gesireiter, Peter B. Byrd and Sam M. Taylor. Construction will be commenced about the first week in January. The capital stock of the company is $300,000.

MANUFACTURING NOTES.

The Victor Telephone and Manufacturing Company, of Chicago, report the sale last week of four switchboards to the State Belt Company, of Hazelton, Pa., and state they are meeting with an unqualified indorsement of their switchboard.

The Shelby Electric Company, Shelby, Ohio, sends out the following little poster: "What can you save if our lamps burn longer, brighter, and with less current than those you use? We can't get rich on one order, and if lamps are not satisfactory you can return them any time within 30 days. But a trial will prove to you they are the best on earth."

The Western Electrical Supply Company, 10 and 12 North Ninth street, St. Louis, Mo., have secured the general selling agency for the Warren Electric Manufacturing Company and also for the Moloney Electric Company, manufacturers of the Moloney transformers. They are also prepared to make shipments of the Adams-Bagnall alternating enclosed arc lamps.

Among the numerous well known wire companies that exhibited at the Trans-Mississippi Exposition at Omaha, the Indiana Rubber and Insulated Wire Company, of Jonesboro, Ind., received the highest prize awarded for excellence in rubber-covered wires and cables. The handsome exhibit, as well as the perfectly constructed wires and cables of the Indiana Rubber and Insulated Wire Company, attracted considerable attention throughout the exposition, and the company received many compliments concerning the same. Mr. Lucas, the secretary of the company, reports an extremely good business during the past few months, and orders are being received from all parts of the world, compelling the employment of an extra night force to handle them.

The Eureka Electric Company's New No. 44 Transmitters—This instrument for beauty of design and symmetry is claimed to be unequaled; also for volume of tone and clearness of articulation. It is of superior construction, has a metal diaphragm, but does not employ any other elements in its construction other than carbon and metals, using no wood or electrose backs. It is of the solid-back type, full nickeled and is built to be mounted upon both the magneto box, also on the long-distance arms. Its construction is such that packing is said to be out of the question, and the company guarantees each transmitter indefinitely. This transmitter in connection with the company's new double pole receiver makes a set that is capable of any long-distance work that may be exacted of it. It is the contention of the company that there is no transmitter its equal sold for its price. The company will be pleased to give further particulars.

NEW READERS OF THE ELECTRICAL REVIEW.

The ELECTRICAL REVIEW, in its career of some 17 years, has never before recorded a subscription increase equaling the concluding days of 1898. While this may be attributed to quite an extent to the prosperity of the country, we still have the modest thought that, perhaps, the merit of the ELECTRICAL REVIEW, as a wide-awake electrical journal, is being appreciated.

It is our abiding faith that the ELECTRICAL REVIEW has more subscribers who pay for it and read it than any similar journal in this country.

We have never been a noisy circulation claimant, as such things are generally very largely discounted in the minds of the public, but we do believe that a journal that will have been in existence by the end of January, 1899, for the good, round period of 17 years, and is now more widely read, more widely quoted, more influential, and possesses a larger list of subscribers and a larger list of advertising patrons than ever before, is entitled to a modest word of self-congratulation.

The new subscribers that the daily mail brings to this office are from all parts of the world. The order we publish herewith is so much to the point—not a word wasted—that we present it, and it is but one of a great many:

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If there is any electric-lighting company in the United States, central station or isolated, or any other electrical company, that is not a regular subscriber to the ELECTRICAL REVIEW, we would call attention to the above succinct and comprehensive model of the way to subscribe.

Electrical.... Patents.

[Specially reported for this journal by E. S. Duvall, solicitor of patents, Loan and Trust Building, Washington, D. C. Copies of any patent may be secured for 10 cents each.]

ISSUED DECEMBER 13, 1898.

615,669 Thermostat; I. F. Beers, Rochester, N. Y.

615,673 Method of and apparatus for electrically transmitting power; C. S. Bradley, Avon, N. Y.—The method of altering the rate of an alternating current, consisting in leading said current through a motor generator feeding an armature from the secondary of said generator, and varying the strength of the field magnetism, cooperating with the armature to adjust the capacity of the circuit to the required rate.

615,686 Electric lamp; W. S. Doe, Jersey City, N. J.

615,691 Method of manufacturing electrical cables; S. Z de Ferranti, Hollinwood, Eng.—The method of manufacturing electric cables for electric-light and power distribution, which consists in first forming a circular stranded conductor, passing the same between rolls to compress it to the shape of part of a circle in cross-section, insulating said conductor, and lastly, laying a number of such conductors together to form an approximately cylindrical cable as set forth.

615,695 Hysteresis meter; J. L. W. Gill, Montreal, Can.—A meter or instrument for measuring hysteresis in iron, comprising a solenoid adapted to have a motion along the sample of iron being tested with means for operating such solenoid, the specimen of iron being supported so that the force of attraction of the solenoid will proportionally move the specimen and means for indicating the work done.

615,699 Electro-plating apparatus; J. E. Hartley, Birmingham, Eng.

615,723 Fire-alarm indicator; L. Le Baron, Pensacola, Fla.

615,731 Dynamo-electric machine; W. M. Mordey, Loughborough, Eng. — An armature, having each element of its winding arranged as a pair of coils, or separate portions so disposed and connected that, during the greater part of the revolution, the electro-motive forces in the two coils or the separate portions are additive, while at the time of commutation they are in opposition.

615,732 Dynamo-electric machine; W. M. Mordey, Loughborough, Eng.—A multipolar dynamo-electric machine provided with a drum armature, having a toothed, slotted or channeled core and a winding, the coils of which composing each element are so arranged as to oppose one another during the moment of commutation, but to aid one another during the greater part of each revolution.

615,762 Railway crossing signal; J. D. Taylor, Chillicothe, Ohio—A signal-sounding mechanism, an electric circuit comprising an induction coil having two primaries and one secondary, an open rail circuit having resistances for controlling one of the primary coils, and a relay operating by an induced current of the secondary coil to operate the signal mechanism, the second primary operating to restore the relay to normal.

615,814 Electric firing device for ordnance; A. T. Dawson, London, Eng.

615,893 Diffusion battery; Jean Perichon, Rodah, Egypt.

615,896 Vacuum insulator for electric conductors; J. A. Poche, New Orleans, La.—An insulator for electric conductors, consisting of a sleeve through which the conductor is adapted to pass, and a chamber surrounding said sleeve and secured thereon air-tight, said chamber being exhausted of air to create a high vacuum therein and form an internal resistance in the insulator.

615,904 Electric-lighting apparatus for railway cars; W. F. Richards, Buffalo, N. Y.—A railway car and its axle, a dynamo mounted on the car, frictional driving mechanism for driving the dynamo from said axle, an adjusting device for regulating the tension of said driving mechanism, and means independent of said adjusting device for throwing said driving mechanism out of gear for stopping the dynamo.

615,905 Electric-lighting apparatus for railway cars; W. F. Richards, Buffalo, N. Y.

615,927 Electric arc headlight; W. G. Wagenhals, Dayton, Ohio.

615,952 Alternating-current generator; C. S. Bradley, Avon, N. Y.—An alternating-current generator having one member excited by a free-running dynamo-electric machine whose field magnet is charged by a direct current of variable strength.

615,953 Controlling alternating-current motors; C. S. Bradley, Avon, N. Y.

615,954 Changing period and phase of alternating currents; C. S. Bradley, Avon, N. Y.—The method of altering the rate of an alternating current consisting in leading said current through a motor-generator feeding a work circuit from the secondary of said generator, and controlling the rate by altering the phase relation of the work current.

616,035 Electric motor; J. L. Thoma, Kansas City, Mo.

616,046 Telephone switchboard; T. F. Ahearn, Detroit, Mich.

616,049 Electrical bedbug exterminator; F. M. Archer, New York, N. Y.—A bedstead, one or more pairs of electrical contacts consisting of strips, surrounding the bars or framework of the bedstead and insulated from each other, whereby an insect, in traversing the bar or frame in the direction of its length, must necessarily close the circuit between the contacts and a source of electricity connected with said contacts.

616,063 Ball-bearing for electric motors; J. M. Murphy, Torrington, Ct.

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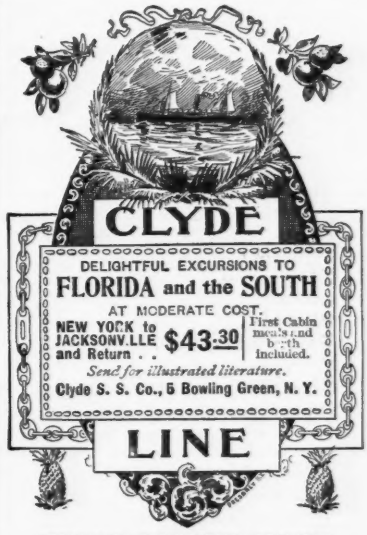
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Kindred.... ...Interests

Mr. H. G. Issertel, formerly with the New York office of the Walker Company, of Cleveland, will open an office for the Anchor Electric Company, of Boston, in the Havemeyer Building, New York.

The Westinghouse Electric and Manufacturing Company has obtained an order from Hanover, Germany, for the electrical equipment of about 50 cars, comprising motors and controllers, for an electric railway in that city.

The Warren Electric and Specialty Company, of Warren, Ohio, manufacturers of the "Peerless" incandescent lamps, have sent to their friends and customers a souvenir of their recent prize-name contest. It consists of a sheet of aluminum, on which is printed the portrait of a beautiful woman, below which appears a neat advertisement of the "Peerless" lamps. The sheet of aluminum is mounted on a folding easel, and forms a remarkably attractive advertising device.

The "Big Four" route is now running four fine trains, named as follows: "New York & Boston Morning Special," between St. Louis and western points and the East; "Knickerbocker Special," the "Southwestern Limited" and the "White City Special," the latter running between Cincinnati, Louisville, Indianapolis and Chicago. This great railway system is thoroughly up to date in all its equipment, and is one of the very popular routes between the eastern coast and the middle West.

The Electric Appliance Company have taken the general western agency for the well known Crescent tin shade. This shade has been designed with a view to displacing the ordinary flat tin shade, and it is being manufactured in such large quantities that it can be sold for even a less price than the flat shade. It is curved in shape to concentrate the light as much as possible, and has its bright surface corrugated to give a good distribution. It should certainly find a large field where the demand is for a durable and inexpensive shade or reflector.

The Western Electric Company, Chicago, in order to promptly fill orders, now carries a complete stock of Stanley induction single-phase and two-phase motors. The former are made only in two sizes; viz., one-fourth and one half horse-power, for either 50 or 100 volts and for 5,000 or 16,000 alternations. The two-phase motors (for either 8,000 or 16,000) range in sizes from 1 to 40 horse-power. A complete stock of motor transformers is also carried. Full description and prices will be sent to those who are interested.

The Pennsylvania Electric Company, of Marietta, Pa., informs the ELECTRICAL REVIEW that it was the fortunate recipient of the highest award for superior telephone apparatus shown at the Trans Mississippi and International Exposition, Omaha, Neb., which has just closed. A very handsome medal, bearing the inscription "Highest Award Pennsylvania Electric Company, Marietta, Penna.," and also a beautiful steel-engraved certificate, properly sealed and executed by the exposition officials, are proudly displayed at the offices of the company. The company is now busy filling an order for 2,000 telephones from the Independent Telephone Company, of Lancaster County.

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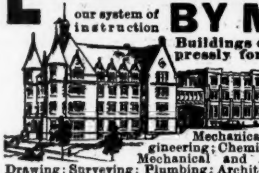

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